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PURULENT NASAL DISCHARGES

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PURULENT NASAL DISCHARGES

THEIR

DIAGNOSIS AND TREATMENT

BY

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PREFACE TO SECOND EDITION.

THE contents of the following pages form the second edition of the subject matter of a series of three lectures which first appeared in book form about twelve months ago; owing to the kindly way in which this little work was received I have been emboldened to prepare a second edition, which has entailed a careful revision and considerable extension of the first edition with the addition of six plates and many new illustrations.

My main object has been to present a concise and practical account of chronic suppuration of the nasal accessory cavities, concerning the symptoms, diagnosis and treatment of which, our knowledge has so greatly increased during recent years, but respecting which very scanty information is to be found either in our general surgical textbooks or even in most of the special treatises devoted to diseases of the nose. Part II. has been entirely relegated to this, the most difficult and interesting branch of nasal suppuration. Part I. has only been included in this edition in order that the work may be more complete and of some use to the general practitioner in the treatment of the more common forms of nasal suppuration with which he has so often to deal.

I would ask for the indulgence of my readers in the somewhat frequent use of the personal pronoun, and possibly for the colloquial style of certain passages; my excuse must be that the matter was first delivered in the form of lectures and that I have endeavoured throughout to write almost entirely from my own practical experience.

In the course of the text will be found an acknowledgment of the kindness of friends who have lent me illustrations or otherwise helped me; I heartily thank them for their valuable assistance.

HERBERT TILLEY.

HARLEY STREET, W.
May, 1901.

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PURULENT NASAL DISCHARGES

THEIR

DIAGNOSIS AND TREATMENT.

INTRODUCTION.

To devote a treatise, however small, to such a limited subject as the one in hand, might at first sight seem worthy of an apology from the author. Such indeed would be the case if the object of the following pages was to deal with, and unduly magnify, the importance of some pathological curiosity whose chief virtue lay in its rarity or in our ignorance of its nature and its influence upon the well-being of the economy.

Of purulent nasal discharges it may be said, that they certainly are not uncommon, that they are of very considerable importance, and it may be added without fear of contradiction that the surgical treatment of some of the chronic suppurative affections of the nasal accessory cavities, has so vastly improved during the past ten years that rhinology may claim a foremost place in that general advance which, during this epoch, has characterised the surgical treatment of diseases of the more specialised organs of the body.

With regard to the frequency of nasal suppuration I need scarcely say anything, for the physician, surgeon, and general practitioner are constantly meeting with such cases; they may occur at any period of life from the early weeks of infancy to adult years, but my own experience is that it is uncommon to meet with purulent nasal discharges in people over sixty years of age.

The importance of a purulent nasal discharge cannot be over-estimated when considered in its relation to the general well-being of the individual. We may glance for a moment at the case of a patient suffering from a chronic empyema of the maxillary antrum of a few months' duration. Under such conditions there exists a reservoir of pus which is often horribly offensive and teeming with many varieties of septic organisms in which the staphylococcus pyogenes aureus and albus and streptococci predominate. Week in, week out, morning, noon, and night, the contents of this reservoir of septic matter are constantly overflowing into the nose, and passing backwards into the pharynx, are swallowed. Fortunately, a certain amount of the poison is rendered harmless by the free hydrochloric acid of the gastric secretions, but when the quantity of pus is increased, the result is soon manifested in various forms of gastric catarrh and their associated symptoms of "indigestion." Dr. William Hunter has, in an able article,* pointed out that oral sepsis, more especially in connection with carious teeth, is a potent cause of many forms of ill-health, "septic gastritis, toxic neuritis and other septic conditions"; his arguments apply equally and with even more weight to purulent nasal discharges in which the dose of poison is often larger than in dental caries.

In such a case (antral empyema) as we are considering, the general health is often profoundly affected. The appetite is gone, while nausea, flatulence and pain follow the ingestion of the little food which is taken. Such symptoms, associated with a sallow complexion, loss of weight and general lack of vitality often present a striking resemblance to malignant cachexia. Furthermore the loss of energy, mental depression and lack of interest in the affairs of everyday life bespeak the subtle effect upon the nervous system induced by the constant absorption of septic matters into the system.

---

* *Practitioner*, Dec., 1900.

That chronic septic poisoning is the true explanation of such symptoms is proved by the almost sudden recovery when the source of sepsis is removed. A patient who had suffered from a chronic antral empyema *for ten years* said to me, two days after washing out and draining the cavity:—"This is the first time for nearly ten years that I know what it is to feel really well and to enjoy my food," and in another instance:—"I have never felt so well in my life as since my antrum was drained, I have no difficulty with my work and have put on seventeen pounds in weight during the past two months."

I need not further emphasise the importance of the subject, except once again to add my testimony to that of Dr. Hunter's as to the necessity of not overlooking the possible septic origin of many of the so-called simple ailments of every-day life.

In the following pages attention will be mainly drawn to those diseases in which the purulent nasal discharge is the symptom which is of the most importance to the patient, and which is possibly the sole cause of his seeking advice, and I shall pass quickly over other conditions where the discharge is of secondary importance, for example, in the acute specific fevers.

My main desire is to discuss as fully as possible those diseases of the nasal accessory cavities characterised by a purulent discharge; but these being the most complicated, they can best be approached by first dealing with some of the simpler conditions associated with that symptom. In order to facilitate matters the following rough classification may help in the review of the subject.

Purulent nasal discharges may be arranged under the following six headings:—

PART I.

I. **Those met with in early infancy,** *e.g.*:—

Gonorrhœal or leucorrhœal infection.
Congenital syphilis, *e.g.*, the so-called "snuffles."

II. **Discharges associated with the exanthemata and other acute infectious disorders,** *e.g.*:—

Measles.
Scarlet fever.
Diphtheria.
Glanders.
Smallpox.

III. **Nasal manifestations of constitutional disease in the adult,** *e.g.*:—

Syphilis.
Tubercle (including lupus).

IV. **Pathological conditions of the nasal or post-nasal mucous membranes,** *e g.*:—

Adenoid growths of naso-pharynx.
Late stages of acute rhinitis.
Certain cases of hypertrophic rhinitis.
Atrophic or fœtid rhinitis (ozæna).
Purulent rhinitis of children.
Strumous rhinitis.

V. **Foreign body in nasal cavity.**

PART II.

VI. **Disease of the nasal accessory cavities,** *e.g.*:—

Maxillary antrum.
Frontal sinus.
Ethmoidal cells.
Sphenoidal sinus.

PART I.

CHAPTER I.

PURULENT NASAL DISCHARGES MET WITH IN EARLY INFANCY.

(*a*) **Infection by Gonorrhœal Discharges.**—Where the disease occurs in the new-born child the discharge is profuse and there is great swelling of the nasal mucous membranes, whilst the conjunctivæ are nearly always simultaneously affected.

If the child be infected at birth the discharge usually commences before the fourth day; if it begin much after this date it is probable that the infant's face has been wiped with a towel soiled by the vaginal discharge of the mother.

Symptoms.—These comprise a profuse discharge of foul, irritating pus from the swollen nasal mucous membranes; nasal breathing, so natural to the infant, is prevented, and hence it is unable to take the breast and has to be fed with a spoon, whilst its suffocative attacks render it a source of anxiety to all concerned.

Treatment.—The nostrils should be cleansed by means of a probe supporting small mops of wool soaked in warm boracic or soda solution. Syringing should not be employed because of the danger of forcing the infective material into the Eustachian tubes. Having thus cleansed the nasal cavities, two to three drops of a five per cent. solution of cocaine in liquid paraffin may be dropped into each nostril (a clean fountain-pen filler does well for this); the cocaine will cause contraction of the mucous membrane, and for a while the child can breathe through the nose, may be properly nursed, and is altogether more comfortable.

In addition to the above, a spray of 1 in 5000 warm perchloride of mercury lotion may be sprayed into each nostril three or four times daily. Such cases are fortunately not common.

(*b*) **Inherited Syphilis.**—Here the purulent discharge is one of the commonest and earliest symptoms of the constitutional taint, and commonly goes by the name of "snuffles." If not at first it, as a rule, soon becomes associated with other symptoms, *e.g.*, diffuse erythema, pemphigus of palms and soles, fissures at the corners of the lips, mucous tubercles around the anus, the discoloured skin, evidences of malnutrition, &c.

The purulent discharge from the nostrils is offensive and irritating, and the nostrils soon become red and sore. If the patient be not quickly placed under efficient treatment ulceration takes place within the nose, and bone and cartilage become attacked, with the result that there is produced the hideous disfigurement seen in the bridgeless noses of congenital syphilis.

Treatment.—The nostrils should be kept clean by means similar to those already stated, whilst constitutional treatment is being carried out. This consists in giving the child one grain of the Pulv. Hydrarg. c. Cretâ twice daily, the effect on the bowels being watched. Should diarrhœa be produced a small quantity of compound ipecacuanha powder can be added to the mercury powder, or it may be necessary to reduce the dose of the latter.

In some cases mercury given internally is ill borne, and then inunction of the ointment may be tried. Some 20 grains should be diluted with an equal quantity of lard, spread on flannel, and wrapped round the child's waist every night.

Improvement is often rapid, but the treatment should be carried out for at least six months with few remissions, while the dose of the mercury may be lessened as progress becomes marked. During this time very sedulous care must be maintained in keeping the child free from colds and thoroughly well nourished. The latter is sometimes a very difficult matter because of the spoon feeding which is necessitated by the nasal obstruction.

If the mother is known to be syphilitic, treatment by ante-natal therapeusis will, of course, be the best prophylactic as regards the child.

CHAPTER II.

DISCHARGES ASSOCIATED WITH THE EXANTHEMATA AND OTHER ACUTE INFECTIOUS DISEASES.

In the exanthemata a purulent nasal discharge is not uncommon, especially in measles and scarlet fever. In the former the nasal discharge is at first watery, later on it becomes purulent. In scarlet fever where the throat symptoms are severe, *e.g.*, ulceration of tonsils, palate, &c., with enlarged glands in the neck, the nose often becomes blocked with an acrid purulent discharge, which makes the nostrils and upper lip red and sore. At the same time there is very great danger of the Eustachian tube and middle ear being similarly infected, with results not only very serious to the patient's hearing but also to life, because of the mastoid and intra-cranial complications which may follow the acute and virulent infection.

In both measles and scarlet fever the nasal cavities should be gently sprayed or irrigated with warm boracic, bicarbonate of soda (gr. v. to x. ad ℥j.), carbolic, or sanitas lotions in suitable strengths. In elderly children it may be possible to remove membranous deposits or viscid discharge from the nose by means of cotton-wool mops or even fine forceps. In such cases, after the nostrils have been cleansed it is wise to make use of a nebulised spray containing some essential oil in solution (p. 26).

Similarly in diphtheria, small-pox, and glanders profuse purulent, irritating discharges may occur, and the treatment of this complication is practically the same for all of them, namely, constant cleansing by means of suitable antiseptic lotions.

It should be particularly borne in mind that in syringing out the nasal cavities under these circumstances, no force should be used, because the infective material may be driven into the ears *viâ* the Eustachian tube, and produce those very complications which it is intended to avoid, and for which purpose the nasal and naso-pharyngeal mucous membranes should be constantly cleansed.

CHAPTER III.

NASAL MANIFESTATIONS OF CONSTITUTIONAL DISEASE.

(*a*) **Syphilis.**—Apart from the inherited form of the disease as seen in infants and young children the tertiary manifestations are those most commonly seen in adults, and these may take the form of either gumma, ulceration, or necrosis of bone and cartilage.

The parts usually affected are those forming the cartilaginous and bony septum of the nose.

When ulceration occurs, and still more so when bone is necrosing, the purulent discharge is often tinged with blood, and it has a disgusting penetrating odour unlike any other disease, and quite distinct from that of atrophic rhinitis. The ulceration is, as a rule, deep and irregular, and often the nasal cavity is blocked by large granulations, especially when they surround a piece of necrosed bone which is in process of separation.

The ulceration may spread so that the hard and soft palate become perforated or even so totally destroyed that on looking into the mouth a dome-shaped cavity is seen covered with a tenacious muco-purulent secretion, amongst which the remains of the turbinate bones may be observed, while the ulcerating surface extends downwards over the pharyngeal region.

Under such circumstances the nasal accessory cavities should be carefully examined because it is not improbable that some of the purulent discharge has its origin within them, the nasal infection having spread by continuity of mucous membrane to the surrounding sinuses.

Diagnosis.—If, in a patient suffering from a unilateral or bilateral fœtid nasal discharge, the nasal cavities are examined and an irregular ulcerated surface is seen upon the bony or cartilaginous septum or upon both, tertiary syphilis may be strongly suspected. The suspicion would be strengthened if within the confines of the ulcerated surface bare bone or a sequestrum were detected by means of a nasal probe. Occasionally such patients complain of pain in the nose increasing towards night, and also of nasal obstruction, which may be due to the presence of granulations or polypi growing from the region of the ulcerated surface.

Treatment.—These cases do exceedingly well under iodide of potash and mercury in solution. The following is a useful prescription:—℞ Potassii Iodidi gr. v. to x., Liquor Hydrargyri Perchloridi ʒss. ad ℥j., Decocti Sarsæ Compositæ ad ℥j. S. *Ter die sumend.*, *post cibos.* Inunction of mercury sometimes produces excellent results when its solution in combination with iodides seems to have lost its effect, or when the system will not tolerate it administered internally; in fact, inunction of mercury in nasal syphilis is often characterised by most excellent results. Coincidently with general treatment the nasal cavities should be freely douched with a warm alkaline wash, to which sanitas, creolin, or listerine may be added. Where the fœtor is unbearable, iodoform powder pure, or mixed with an equal quantity of boracic acid powder is the best means of overcoming the smell, while the iodoform seems to possess a special healing action of its own in such cases. It is almost needless to remark that any loose sequestra of bone should be removed.

(*b*) **Tubercle.**—Local tubercular disease of the nasal cavities is rare, especially in the form of a tubercular swelling or ulcer, not so rare if we include the extension inwards of lupus from the skin. The swelling or nodule is the commonest form of tubercular growth and the main symptom it produces is that of nasal obstruction. When an ulcer is present it is generally its dried secretion which produces obstruction. In other cases there may be muco-purulent, purulent, or blood stained discharge.

The most frequent site of the tubercular deposit is the anterior part of the cartilaginous septum (70 per cent., Steward). In six per cent. of his collected cases the last named author found that the inferior turbinal was alone diseased, and in a further six per cent., the septum, floor, and inferior turbinal were affected. The ethmoidal regions were only diseased in one per cent. of the cases.

The appearances of these tubercular deposits may be best described in Steward's* own words:—"After removing any discharge and crusts that are present in the nostrils, examination reveals a pinkish sessile tumour, which may be ulcerated on the surface, or else a red infiltrated area which is the seat of one or more shallow ulcers, with uneven bases, covered with yellow discharge or dried crusts. The tumours and infiltrated areas, as well as the surrounding mucous membrane, are generally markedly vascular and easily bleed when touched with a probe. The staining of the discharge with blood is probably caused by injury inflicted on these vascular growths by attempts to clear the nostrils."

Often the patient has no pulmonary manifestations of tubercle, but the typical bacillus can be obtained for diagnostic purposes from the nasal tubercular deposits by curetting the ulcer as deeply as possible, or by removal of some of the growth by means of a snare or curette. This should be done under cocaine or a general anæsthetic.

---

* F. J. Steward, *Guy's Hospital Reports*, vol. 54.

Diagnosis.—Tubercular nasal lesions might be difficult to distinguish from certain syphilitic or malignant manifestations. In syphilis the purulent discharge would be very fœtid and associated with a deep and more extensive ulceration and possibly with necrosed bone.

A tubercular ulcer is altogether more superficial and indolent and the discharge inoffensive. It would not be improved by iodide of potash, and furthermore it is comparatively easy to detect in the growth or ulcer the tubercle bacillus and thus at the same time distinguish the tubercular lesion from malignant disease.

Treatment.—The tubercular ulcer should be thoroughly scraped and then pure lactic, pyrogallic, or chromic acid rubbed in. By such treatment (which is best carried out under a general anæsthetic) these cases often do well.

The discharge in lupus is often very slight, the main trouble being caused by the obstruction produced by the lupoid nodules.

I have cured a case where the inferior turbinate and anterior part of the floor of the nose was affected by lupus, by free curetting under a general anæsthetic, then drying the parts well and rubbing in trichloracetic acid. There was no sign of return four years after the operation, but the elevation of the ala nasi upon the side operated on showed how complete had been the cicatrising process.

CHAPTER IV.

PATHOLOGICAL CONDITIONS OF THE NASAL OR NASO-PHARYNGEAL MUCOUS MEMBRANE.

(*a*) **Adenoid Vegetations of the Naso-Pharynx.**—The majority of cases of bilateral muco-purulent discharge from the nostrils of children is due to the above cause—the catarrhal secretion passing into the throat as well as appearing at the anterior nares. This combination of lymphoid overgrowth with excessive secretion produces the well-known symptoms of adenoids, *e.g.*, mouth breathing, snoring, deafness, ear complications, deficient physical development, mental apathy and other well-known constitutional defects.

Diagnosis.—The combination of such symptoms with a muco-purulent nasal discharge in a young child is almost pathognomonic of adenoids. In order to make absolutely certain of the presence of the growths, the naso-pharynx should be examined by the index finger. The expert laryngologist or rhinologist may often save the patient the discomfort of this examination by examining the naso-pharynx with a small laryngeal mirror and reflected light.

Treatment.—When well marked symptoms are present the growth should be removed. The operation, now so well known, scarcely needs detailed description; every surgeon prefers the instrument he is most used to, a particular position of the patient, and has his own ideas as to the best anæsthetic. Personally, I use a modification of the Delstanche-Gottstein ring knife (fig. 1), the patient's head is allowed to hang over the end of the table directly the operation commences, and whilst nitrous oxide, or "gas" anæsthesia, is suitable for a number of cases, I prefer chloroform if the patient is very nervous, because its administration causes less alarm than that induced by the complicated apparatus used for the shorter anæsthesia. Gas and ether is in common use, and I have had it given many times by skilled anæsthetists, my only objection to it is that it tends to increase the hæmorrhage, and of this I am certain. Its safety and the rapid recovery of the patient from the anæsthetic constitute its main claims to popularity. Directly the growth is removed the patient should be at once placed on the left side, the head being held at a little lower level than the body, while the jaws are held open in order that (*a*) the blood may easily flow from the mouth, (*b*) the air may have a free entry into the lungs and so relieve any tendency to congestion which would increase the hæmorrhage. When one of the various forms of adenoid forceps are used in the removal of post-nasal growths, the operation may last from five to fifteen minutes and under these circumstances a prolonged anæsthesia is of course necessary.

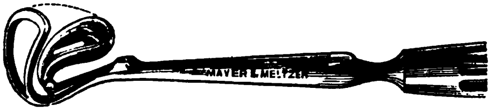

FIG. 1.—Delstanche's curette.

Formerly, from time to time I accustomed myself to the removal of adenoids by both methods, *i.e.*, either by means of forceps or by some form of ring-knife or curette, but during the last five years I have entirely discarded the forceps in favour of the curette. The latter instrument gives the most perfect results and the time taken in the operation is immeasurably shorter than when forceps are used.

The only exception to this rule is in young adults in whom the adenoid mass may be so fibrous that forceps are necessary to remove it. Fig. 2 illustrates an excellent instrument for this purpose.

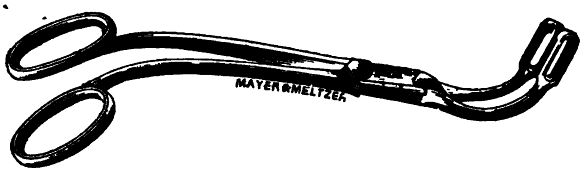

FIG. 2.—Jurac's modified post-nasal forceps.

(*b*) **Late Stages of Acute Rhinitis.**—As a rule, after twenty-four or thirty-six hours of sneezing, accompanied by a clear nasal discharge, the latter becomes muco-purulent and then purulent.

This condition lasts some five to ten days, and then gradually disappears as the mucous membrane returns to its normal condition.

Treatment.—A warm alkaline antiseptic douche* will give very great relief, and tend to bring about a healthy condition of the mucous membrane. For suitable apparatus and mode of using samein nasal douching, *vide* footnote, page 25.

When such a condition, following an acute cold, remains chronic, it is not improbable that an ethmoidal cell, or even the antrum has become infected during the acute stage by some pyogenic organism, and that in such a simple beginning as a "cold" we have the origin of a chronic empyema of an accessory nasal cavity (*vide infra*).

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* ℞ Pot. Chlor., Sod. Bibor., Pot. Bicarb., āā ℥ss.; Sacch. Alb. ad ℥ij. ʒss. in half a tumblerful of lukewarm water.

(*c*) **Certain Cases of Hypertrophic Rhinitis.**—In the great majority of cases of this disease the discharge is somewhat excessive and clear, but occasionally it is muco-purulent or purulent, and this without any accompanying disease of the nasal accessory cavities. When such a discharge is present it is in cases of long standing, and the mucous membrane of the inferior turbinate is often found to have undergone the so-called moriform hypertrophy. This condition is brought about by degenerative changes in the tissue leading to distension of the venous spaces, with more or less morbid increase of the mucoid and lymphoid elements which go to make up the mucous membrane of the inferior turbinate body.

These moriform or mulberry-like growths are more commonly situated on the anterior or posterior extremities of the inferior turbinate bone, but in well-marked cases a fringe of similar structure extends continuously along the whole lower border of the bone. Such a condition is a common cause of nasal obstruction.

It is difficult to understand why the secretion should be purulent in some of these cases; possibly it is because stagnation of the nasal discharge constantly occurs, owing to the almost continuous occlusion of the nasal passages by the swollen mucous membrane. In young adults this condition is not uncommonly associated with the tough remains of old adenoids, both of which aid in producing the excessive secretion.

Diagnosis.—Anterior rhinoscopy carried out by means of a speculum and reflected light will in many cases reveal the pink moriform termination of the mucous membrane of the inferior turbinate bone which passes backwards into a less marked but similar condition of hypertrophy forming a fringe along the lower border of the bone. Often the condition can be shown to be more extensive than is apparent at first sight, by passing a probe along the concavity of the inferior turbinate, when the mulberry-like fringe can be turned into the respiratory passage, it having been tucked away, as it were, into the concavity of the bone.

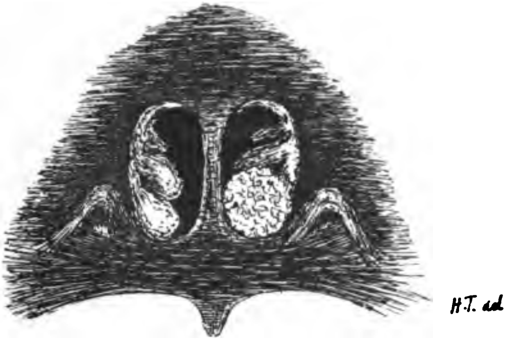

FIG. 3.

Posterior rhinoscopy reveals a similar appearance except that it is usually more marked than anteriorly, and is often well developed in this situation alone (fig. 3). The hypertrophy may be so extreme as to quite occlude the posterior choana, thus rendering nasal breathing impossible.

The application of a 10 to 15 per cent. solution of cocaine produces a partial, and sometimes almost complete retraction of the swollen mucous membranes, forming these hypertrophic growths.

There should be no difficulty in recognising this condition, for anterior and posterior rhinoscopy, or both (especially after the application of a 10 per cent. solution of cocaine), show the appearances described above. The pink moriform surface of mucous membrane in the respiratory tract, firmly attached to the inferior turbinate bone, is very different in appearance from the bluish-grey translucency of a pedunculated polypus arising higher up from the outer wall of the nasal cavity.

A nasal probe is a very useful aid to diagnosis in this as in all intra-nasal diseases.

Treatment.—Slight conditions of this form of hypertrophic rhinitis may be much relieved by using, morning and evening, a lukewarm alkaline nasal douche: Sod. Bicarb. gr. v., Sod. Chlor. gr. v., Boracis gr. v., Sacch. Alb. gr x., Aq. ad ℥ j. ʒss. of listerine solution added to the above makes a very fragrant and agreeable wash. In gouty or plethoric individuals the daily evacuation of the bowels and an occasional blue pill and saline will be efficient helps to local treatment. Where the overgrowth is sufficiently developed to produce inconvenience from nasal obstruction, or gives rise to a mucopurulent discharge which is not relieved by means of an alkaline douche, then the hypertrophied mucous membrane should be removed.

I rarely use the galvano-cautery for these conditions (moriform hypertrophies) because it needs many applications and eventually the condition tends to return. It is far better practice to cocaine the hypertrophy, and remove it by means of a cold wire snare—an almost painless, very efficient, and permanent treatment.

The best and simplest snare for the purpose is Blake's polypus snare (fig. 4) and it should be loaded with No. 5 or 6 piano wire, which is strong and possesses the necessary resiliency. In removing the posterior hypertrophy the surgeon should insert the left index finger into the naso-pharynx, pass the loop of the snare through the nostril with the right hand and manipulate it over the growth by means of the left index finger. The snare is now tightened up, the surgeon's finger removed from the patient's mouth and wire loop still further tightened until the moriform body is detached. It is well to watch the patient for a few hours after this little operation, and to enforce his keeping quiet lest troublesome hæmorrhage should ensue, which, in the absence of skilled help, might be difficult for the patient to check.

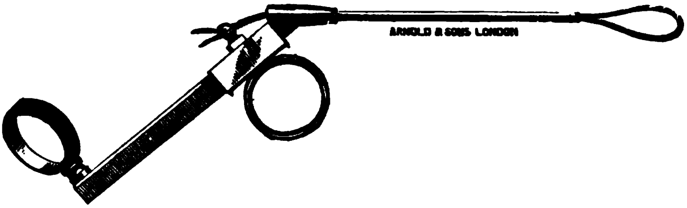

FIG. 4.—Blake's polypus snare.

Atrophic Rhinitis (**Ozæna**).—Here, as the name implies, the disease is characterised by an atrophy of the mucous membrane, accompanied by the formation of characteristically foul smelling pus and crusts, the latter arising from the drying of the secretions within the nose. The crusts are often one to two inches long and when carefully removed may represent with tolerable accuracy the form of the intra-nasal structures upon which they are produced.

Commencing before or about the age of puberty, and most commonly in females, the disease tends to progress until the bony structures of the nose become so atrophied, that often not only is it easy, by anterior rhinoscopy, to see the Eustachian orifices and the posterior wall of the naso-pharynx, but the nasal bones may be themselves affected to such an extent, that the bridge of the nose becomes sunken, producing the well known saddle shaped deformity.

The naso-pharynx and pharynx are often dry and covered with a thin crust similar to that seen in the nose, and in very chronic cases the larynx and tympana may be affected by an extension of the same morbid process.

Not uncommonly only one nasal cavity is diseased at a time, although the condition is more often bilateral. The odour, so objectionable to the friends, is usually unnoticed by the patient, because the olfactory region of the nose is affected by the disease.

Most authorities will agree that there is usually some defect of the general health in those suffering from atrophic rhinitis, but how far this impaired health is a primary or secondary condition it is difficult to say. It is not improbable that the constant swallowing of the septic matter which finds its way into the pharynx from the nose may be largely responsible for the anæmia, gastric disorders, and general debility which coincide with the nasal disease.

Diagnosis.—The formation of crusts of characteristic odour (ozæna) with an atrophic condition of the nasal mucous membranes, generally enables one to recognise this affection at once. The appearance of the nasal cavities occasionally resembles tertiary syphilitic ulceration, but the odour in the two diseases is entirely different, and the ulceration in syphilis is deep and more often confined to the vomer and septal cartilage, whereas there is a general and superficial loss of tissue in atrophic rhinitis to which the term ulceration cannot be properly applied.

The purulent discharges associated with accessory sinus suppuration (*vide* Part II.), cannot be easily mistaken for atrophic rhinitis. The pus in such cases is liquid, and even if fœtid, it has not the characteristic smell of atrophic rhinitis, neither does it possess any special tendency to the formation of crusts.

Treatment.—Since we are entirely in the dark as to the true cause of atrophic rhinitis, the treatment of the disease up to the present has been empirical, and with one or two exceptions (to be mentioned below) has mainly consisted in thorough cleansing of the nasal cavities by means of appropriate lotions.

Possibly our ignorance of the cause of the disease accounts in part for its bad prognosis. We can rarely, if ever, cure a case when once it has developed, but by careful attention to treatment we may promise our patients that the malady shall be robbed of its worst features and probably greatly retarded in its development.

It is true that some observers, such as Grünwald, record many cases of cured atrophic rhinitis. He regards the disease as due to accessory sinus suppuration, and by removing the purulent foci he claims to attain very satisfactory results.

I believe I am expressing the opinion of most, if not all, my British confrères when I suggest that Grünwald classes as "atrophic rhinitis" cases which we should not for a moment place in that category.

It must be remembered in considering this relationship that atrophic rhinitis is common in young adults and children before some of the accessory sinuses are even developed, that it is often hereditary and found in various members of the same family, and that it occurs with far greater frequency in females—features which are not by any means the rule in accessory sinus disease.

It cannot be doubted that if the maxillary antrum is washed out in a case of atrophic rhinitis a small quantity of pus may be found in it, and careful examination of the ethmoidal region may reveal an unhealthy condition of its constituent cells, but this is only what would be expected considering the septic condition of the nasal mucous membrane, and the favourable circumstances offered by the middle meatus for the development of micro-organisms. These facts, coupled with the anatomical relationship of the parts (*vide infra*), will fully account for occasional collections of pathological products in the sinuses, but it is quite another matter to prove that a well-marked case of empyema of the accessory sinuses will eventually produce genuine atrophic rhinitis.

How common it is to find cases of antral and frontal sinus empyemata which have existed for from five to ten years without any evidence of the characteristic crusts or fœtor of atrophic rhinitis!

Particular stress has been laid upon this aspect of the subject because of the important issues which treatment directed to the accessory cavities would involve, and more especially is this the case when such a method is championed by so able a rhinologist as Grünwald of Munich.

The first essentials of treatment are regular and thorough cleansing of the nasal cavities, combined with attention to any marked defects of general health or insanitary surroundings; active local interference is, as a rule, of quite secondary importance. The reason why so many cases do not improve is because the patients are not instructed how to carry out the treatment of cleansing; they are told to "douche" the nostrils night and morning, or "sniff" up a prescribed lotion; possibly they may be directed where and what sort of syringe to get, but they have not the most elementary notion of *how* it is to be used. The patient should be provided with at least a three-ounce rubber bottle terminating in a multi-perforated teat, the latter being of such a size as to just occlude the nostril when introduced within it.* Having filled the syringe with lukewarm lotion, and the teat having been introduced into the nostril, the patient should be directed to hold the head over a basin, breathe in and out quickly through the widely open mouth, whilst he compresses the rubber bottle. A Higginson's syringe fitted with a similar teat also forms an excellent means of cleansing the nasal cavities. By such means purulent or muco-purulent secretion will be efficiently washed out of the other nostril, while any crusts remaining behind can generally be expelled by forcing the air down one nostril while the other is occluded. In thus clearing the nostrils a handkerchief should not be used, because in compressing the nares septic material may easily be forced into the tympanic cavities through the Eustachian tubes.

At least three quarters of a pint of the warm lotion should be used morning and evening. An excellent formula is that recommended for use in hypertrophic rhinitis (p. 20), but a change is often invaluable, and then 1 in 5,000 to 8,000 perchloride of mercury is useful, or where the mucous membrane requires a stimulant, twenty minims of Tr. Sanguinaria Canadensis to a pint of warm water will meet the purpose.

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* Such an one is made for me by Mayer and Meltzer, 71 Great Portland Street.

McBride speaks very highly of a 50 per cent. solution of aceto-tartrate of aluminium, of which the patient is directed to add a small teaspoonful to a pint of water. The strength of the solution may be increased until a slight degree of smarting is induced. A solution of formalin, 1 in 2,000 to 1 in 1,000, has recently been credited with good results by Bronner, of Bradford. He advises a cleansing douche followed by a coarse spray of 1 in 1,000 formalin solution, to which a little glycerine may be added.

Formalin is a powerful antiseptic, and hence it has been also recommended as an agent for cleansing the nose and throat cavities during convalescence from acute infectious diseases, *e.g.*, diphtheria, scarlet fever, &c.

An efficient cleansing wash may also be made from the compound Phenol Soloids, which Burroughs and Welcome have made for me for some six years. (Each soloid is composed of Sod. Bicarb. gr. xij , Ac. Carbol. gr. ½, Sod. Chlorid. gr. v.). One soloid is dissolved in three-quarters of a tumblerful of lukewarm water, and used with a nasal douche in the manner already described.

After thorough douching, it is well to spray each nostril alternately from an atomiser (fig. 5), with an oily solution suspending some of the essential oils, *e g.*, ℞ Ol. Eucalypti ♏x., Ol. Cinnamomi ♏v., Menthol gr. xij., Parolein ad ℥j. The fine oily coating thus deposited over the nasal mucous membranes not only prevents the crusts forming so readily, and hence abolishes much of the smell, but the latter is also overcome to a great degree by the fragrance of the oils contained in the solution. In addition they may themselves exert a healthy influence upon the diseased mucous membrane. Such treatment the patient can carry out at home with the greatest ease.

The surgeon should at intervals supplement this treatment by rubbing stronger applications into the diseased surfaces by means of a suitably curved probe covered with cotton wool, *e.g.*, ℞ Potass. Iodid., Iodi, Ac. Carbol. āā gr. iv., Glycerine, Aqua Destill., āā ℥ss. Ft. app If rhinoscopic examination shows that the crusts tend to form on certain definite areas, it will be an advantage to cauterise such areas with the galvano-cautery or with trichloracetic acid. The inflammatory reaction thus induced will often tend to a diminution in the amount and fœtor of the crusts.

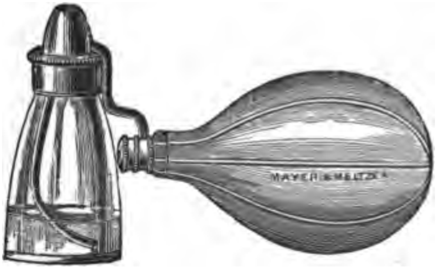


FIG. 5.—Paroline spray.

In particularly obstinate cases Gottstein recommended tightly plugging the nasal cavities with medicated wool which in addition to its stimulating action also produced a free watery secretion. On removal of the tampon the nostrils should be douched with a warm alkaline wash.

The number of measures introduced from time to time for the treatment of "ozæna" (including injection of Roux's diphtheria anti-toxin), all of which claim some degree of success, is a sure proof that no one treatment is efficient for all cases.

In view, however, of the distressing nature of this disease, one must not omit to mention a mode of treatment by cupric electrolysis which was introduced by Jouslain and Cheval and which has been well spoken of by McBride, who says, that in about half of the cases he was able to follow up "there was disappearance of the chief symptoms for eighteen months while most were favourably influenced for a time."

The method of carrying out the electrolysis is best described in his own words:—"The parts are thoroughly cocainised after the nostrils have been freed from crusts; a copper needle attached to the positive pole of a battery is then inserted into the inferior or middle turbinated body, while a platinum (or steel) needle connected with the negative pole is then plunged into the septum. A current of from three to ten milliampères is allowed to pass for about ten minutes.

"Usually a certain amount of pain or discomfort is experienced, but, as a rule, this is not severe, provided the strength of the current be regulated according to the patient's sensibility. In most cases improvement in both nostrils will follow the application to one, but it is often desirable to repeat the operation more than once on each side, at intervals of a fortnight."

I have had no experience of this treatment but have seen cases treated by others and must confess to feeling that one had seen equally good results follow the use of cleansing lotions. Nevertheless the method is obviously one which might be advantageously adopted when there is difficulty in getting rid of the fœtor, especially when the "cleansing" treatment has failed to attain that end.

Briefly, my own plan of treatment is to examine the general health of the patient, and to prescribe for any obvious defects of the same. An endeavour is then made to place them in sanitary surroundings with plenty of fresh air and exercise. When it is possible, a few weeks residence near the muddy shores of the Bristol Channel will be found of great benefit. The patient is instructed in the use of a nasal douche *(vide supra)*, and disallowed all glass syringes (because they cannot use them efficiently themselves), "squirts," and "sniffing up of lotions," while the necessity of regularly douching the nostrils twice daily, followed by the use of nebulised oils from a nasal atomiser (fig. 5) are duly emphasised. The progress of the case is watched, and from time to time the lotions are changed and local applications are made to the mucous membranes if they seem to need stimulation or any special treatment.

Finally, the author cannot but view with suspicion any "operative treatment" of atrophic rhinitis which he has reason for believing is sometimes recommended. The only results which he has noted in such cases have been, that there is an absence of any intra-nasal structures except the septum, while in addition to the knowledge that his malady remains uncured, the sufferer is rendered still more miserable than before, by the addition of a very dry throat and a depressed state of mind.

(*e*) **Purulent Rhinitis of Children (Bosworth).**— This eminent American authority describes such a disease in children, and looks upon it as the precursor of atrophic rhinitis, *i.e.*, the latter is the final stage of the former.

While hesitating to disagree with so able a rhinologist as Bosworth, I must say I have never been able to recognise these cases, although my opportunities for doing so have been favourable. If we exclude those common cases of bilateral purulent discharge in children so characteristic of adenoids, and those symptomatic of a strumous constitution, very few indeed would remain which could be regarded as representing the early stage of atrophic rhinitis.

(f) **Struma.**—In this condition, which was described by Virchow as an "abnormal vulnerability of the tissues," we often meet with a muco-purulent nasal discharge. Examination of the nasal cavities reveals swollen, sodden, unhealthy mucous membranes bathed in thick muco-pus, which is often exceedingly viscid. The pharyngeal mucous membranes are at the same time granular and unhealthy, the voice thick and deficient in resonance, and further evidences of diminished resistance to unhealthy influences are recognisable in other parts of the body.

Diagnosis.—This can only be made by a careful examination of the patient, including his family history and the record of his own health deficiencies, coupled with any manifestations of a strumous nature which may be gathered from a systematic examination.

Treatment.—Constitutional treatment is of the first importance, because we have to treat a general condition first and its local manifestation afterwards; hence good digestible food, fresh air, and regulated exercise, claim the first notice. Locally such cases obtain considerable relief by the daily use of a cleansing wash (p. 26). If further treatment be necessary in order to diminish the secretion or relieve the obstruction, a fine tenotomy knife should be passed into the anterior end of the mucous membrane of the inferior turbinate bone for about one inch from before backwards; the tissues should then be subcutaneously divided from above downwards at their attachment to the bone, the knife being finally withdrawn through the original puncture. By this means the blood-vessels are divided, the mucous membrane is less congested, the glands secrete less, and when internal cicatrisation has occurred the obstruction to nasal respiration is greatly reduced; at the same time there has been no destruction of the nasal mucous membranes, as is the case when these are cauterised. This subcutaneous method may be advantageously used when dealing with other forms of hypertrophic rhinitis, especially if they be mainly due to vascular engorgement.

CHAPTER V.

FOREIGN BODY IN THE NOSE.

This, of course, is an accident most frequent in children. The presence of a foreign body in the nasal cavity, if its lodgment has been of any duration, is generally evidenced by a unilateral purulent or sanguineo-purulent discharge, together with more or less well marked nasal obstruction on the side occupied by the foreign body.

Diagnosis.—When the latter has been lodged for some time it will usually be found partially surrounded by granulations, and a probe passed amongst these will, as a rule, have no difficulty in detecting the extraneous matter. The examination should always be made with reflected light, the nostrils being held open with a nasal speculum.

In nearly all cases chloroform is advisable for such an examination: (1) because the child's nervousness will be a great barrier to careful examination; and (2) even if the patient be tolerant the parts around the foreign body may be so sensitive and swollen that probing is almost impossible.

While a unilateral purulent nasal discharge in a young child should always strongly suggest the presence of a foreign body in the nasal cavity, it must not be forgotten that several cases of antral suppuration have now been recorded in young children.

An early case of unilateral atrophic rhinitis ("ozæna") would be characterised by the production of scabs with a characteristically foul odour, and probably the affected nasal cavity would be abnormally wide.

Congenital syphilis would be suspected if other evidences of its presence existed, *e.g.*, interstitial keratitis, notched incisor teeth, evidence of miscarriages or still-births in the mother, &c. Generally speaking in such cases the discharge would be bilateral.

Treatment.—If the child be of an age to understand that he will not be hurt, it might be advisable to try to dislodge the foreign body by syringing up the sound side whilst the patient breathes rapidly through the widely open mouth. No force must be used because the fluid may be driven into the tympanic cavity and set up acute inflammation of the middle ear. If this method does not succeed, and the patient is intolerant of interference, chloroform should be administered, the exact position of the foreign body ascertained by sight and probe, and an endeavour made to remove it by means of Lister's sinus forceps, a small sharp spoon or hook (*e.g.*, a probe bent over at its end). It is inadvisable to probe freely at first, because the surrounding granulations may bleed and render the rest of the search more troublesome than when care is used.

PART II.

CHAPTER VI.

EMPYEMA OF THE NASAL ACCESSORY CAVITIES.

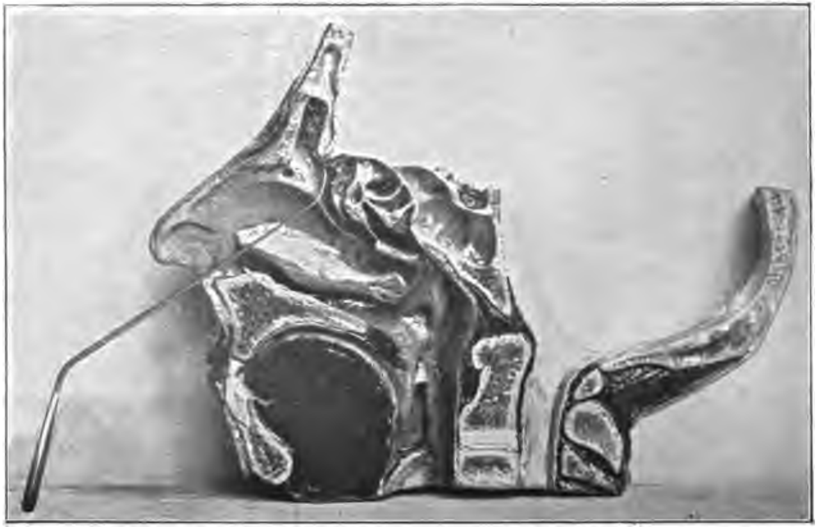
Before commencing the study of this department of nasal disease the student should provide himself with a skull cut in various sections, and capable of such disarticulation as will fully exhibit the antral cavities, frontal sinuses, and nasal passages, with their various relations. (Skulls prepared in this way can be obtained at from £2 5*s*. from the dealers in Osteology in London or Paris).

A moist specimen should also be studied and compared with the dry skull—many of the former may be found in dissecting rooms. The time thus spent will be amply rewarded because so many of the pathological conditions to be reviewed are intimately connected with the anatomical relationships of the parts involved.

Only such relationships will be dealt with here, and for the detailed normal anatomy of the parts the reader is referred to any standard textbook of anatomy.

On each side of the skull there are four nasal accessory cavities.

PLATE I.



THE MIDDLE TURBINAL HAS BEEN REMOVED AND A NASAL PROBE INSERTED INTO THE SEMILUNAR HIATUS AND INFUNDIBULUM OF A CAST OF THE DISSECTED NASAL CHAMBERS. (From De Schweinitz and Randall's *Diseases of Ear, Nose and Throat*, vol. ii. Philadelphia, Saunders).

1. Maxillary antrum . . .		opening into	middle	meatus.
2. Ethmoidal cells	anterior	,,	,,	,,
	posterior	,,	superior	,,
3. Frontal sinus		,,	middle	,,
4. Sphenoidal sinus . . .		,,	spheno-ethmoidal recess.	

The ethmoidal cells have been classed as an accessory cavity for the sake of convenience; there are, of course, many ethmoidal cells, the lateral masses in particular forming a honeycombed structure, the cells of which are lined with a continuation of the nasal mucous membrane. The party walls between them are comprised of very thin bone, deficient in certain spots, by means of which communication between the cells composing the labyrinth is effected.

In examining the nasal cavity by means of a reflected light and a nasal speculum, the patient's head being slightly tilted backwards, there will be noticed, as a rule, three structures.

1. The nasal septum in the mid-line.
2. The inferior turbinate below.
3. The anterior end of the mid-turbinate above and farther back.

Between these last two is a more or less marked cleft, which is the middle meatus—an important region when purulent discharges are being considered, because it is into this meatus that the maxillary antrum, the anterior ethmoidal cells, and the frontal sinus open, by one or more openings or "ostia."

If the outer wall of the nose be examined in the moist specimen, the middle turbinal having been removed, a curvilinear depression called the "hiatus semilunaris" will be seen (Plate I.) and if the depth of this gutter or groove be carefully probed, the openings of the antrum and anterior ethmoidal cells may be discovered. The antral opening is situated at the posterior and lower part of the groove and behind it is occasionally found a smaller or accessory ostium.

The lower lip of the hiatus semilunaris corresponds to the uncinate process of the ethmoid and a well marked swelling of the mucous membrane covering it is very characteristic of chronic antral suppuration. The upper lip embraces in its concavity the ethmoidal bulla, a large bony-walled ethmoidal cell belonging to the anterior group of cells.

Anteriorly and superiorly the semilunar hiatus passes into the lower and widened end (infundibulum) of the fronto-nasal canal, that is to say, the passage which leads towards the corresponding frontal sinus.

In the normal condition of the parts it is often impossible to see the hiatus semilunaris because the middle turbinal is either closely applied to the outer wall or its anterior extremity is slightly enlarged and thus obstructs any view of the meatus.

The openings or "ostia" of the sinuses being situated so near to one another in the hiatus, it is not difficult to understand why the accessory cavities of the nose are so often associated in disease; *e.g.*, with the maxillary antrum discharging pus into the middle meatus, it is more than likely that the associated micro-organisms will find their way into the ethmoidal cells or by the fronto-nasal canal into the frontal sinus. The conditions are very favourable for such a course, for warmth, moisture, and usually very imperfect drainage are present. The anatomical relationships referred to are well shown in the diagram (fig. 6), for permission to use which the author is indebted to Dr. Filliebrown, of Boston, Mass., to whom credit is also due for having drawn attention to certain points in the anatomy of this region.

It will be noticed that the infundibulum terminates at or in the antral opening, and that a fold of mucous membrane extends above the foramen forming a pocket,

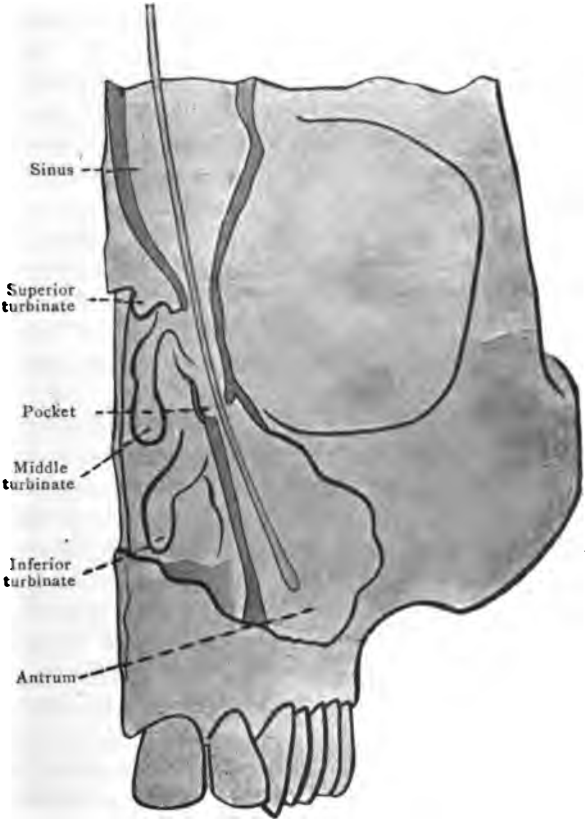


FIG. 6.—Diagram showing relation of frontal sinus to antrum.

at the bottom of which is the antral foramen, the fold referred to being on the inner side (fig. 6). Consequently, a discharge from the frontal sinus would tend to fill the antrum before it began to overflow into the nose, and hence the antrum may act as a reservoir for discharge from the ethmoidal cells or frontal sinus without being itself primarily diseased. Again, Tilleaux has shown that if water be injected into a frontal sinus a considerable quantity of it flows into the corresponding antrum. It is very important, from the point of view of diagnosis and treatment, to bear in mind the fact just referred to, *viz.*, that the antrum may be a reservoir as well as a generator of pus.

Clinically we find these facts amply borne out; it is not uncommon to find that a frontal sinus, the ethmoidal cells, and the corresponding antrum contain pus. If the upper cavities are dealt with so that the supply of pus is cut off, the antral discharge will also quickly cease.

Pus in the middle meatus (unless in an acute suppurative inflammation of one of the sinuses) is often associated with more or less granulation tissue or polypi in this position; these may be so large as to completely prevent nasal respiration, or only like large œdematous granulations filling the meatus itself.

Hence, *given a patient with a chronic, purulent nasal discharge, which on examination is found to come from the middle meatus, the latter containing granulations or polypi, we may be practically certain that we are dealing with an empyema of:*—

1. Maxillary sinus, or
2. Frontal sinus, or
3. Ethmoidal cells, including of course the middle turbinal.

Any one of these conditions may occur alone, or, as is frequent, in combination.

ÆTIOLOGY OF SINUS SUPPURATION.

Empyemata of the nasal accessory cavities may be divided into two great classes, the acute and the chronic. Their ætiology is often identical, for the chronic suppuration is a frequent sequel of the acute inflammation, and for these reasons the origin of the two classes may be discussed at one and the same time.

In the first place it must be remembered that the nasal accessory sinuses are irregular bony cavities lined by a mucous membrane continuous with that of the nasal fossæ, and that these cavities communicate with the nasal chambers by small apertures, which in the case of the antrum and ethmoidal cells serve very inefficiently, on account of their position, for good drainage.

The nasal mucous membrane is very liable to catarrh, and its continuity with the lining of the accessory cavities renders the latter prone to like conditions by simple extension of the catarrhal process.

Hence there is no difficulty in conceiving that an acute nasal catarrh may be followed by a similar condition with retention of the secretions in the accessory sinuses. The frontal discomfort accompanying an acute "cold in the head" is very probably due to the catarrhal inflammation of the mucous membrane of the frontal sinus.

If such secretions be retained under tension where drainage is insufficient, increased inflammation may result, and the access of pyogenic micro-organisms to the suitable medium thus provided may result in suppuration, possibly in the antrum or it may be limited to a single ethmoidal cell.

The primary nasal origin of certain empyemata may be accounted for in this manner.

In other instances the sinuses seem especially prone to acute suppuration during the course of, or convalescence from, certain of the acute infectious diseases, such as influenza, erysipelas, enteric, measles, scarlet fever, and diphtheria. During recent years influenza has seemed to be an especially potent factor in the causation of empyema of the nasal accessory cavities. An interesting case of direct infection is recorded by Luc (Paris) in which a medical student was attacked by acute frontal and maxillary sinus suppuration after attending a post-mortem examination of a patient dying of pneumonia. A pure cultivation of pneumococci was obtained from the pus removed from the student's sinuses.

Under such circumstances as these it is highly probable that the ethmoidal region is first affected and the other sinuses secondarily.

While the above named sources of infection may be the cause of acute antral suppuration,* yet, as a general rule, I think inflammation of this cavity is set up by septic matter associated with a carious tooth. It is difficult to be certain in this matter because, unless the inflammatory products are retained under tension, patients rarely present themselves for treatment during the acute stages of the disease.

With regard to traumatism, I have notes of two cases of acute frontal sinus empyemata, both of which were due to kicks from a horse upon the left sinus.

Grünwald also relates cases† of acute traumatic infection of the antrum, ethmoidal, and sphenoidal sinuses. The careless use of the galvano-cautery in the region of the middle meatus has, to my knowledge, been the cause of acute ethmoidal and antral suppuration.

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* See account of a personal experience by Sir Felix Semon, *Lancet*, 1890, p. 968.

† "Nasal Suppuration," (Lamb).

Among rarer factors of the same are the larvæ of various flies and worms, which may gain access to the accessory cavities (Grünwald).

As already stated many chronic empyemata are but the sequel of an acute suppuration, but there are others which seem to be chronic from the commencement. This is especially the case with antral suppuration, and arising secondarily from this, ethmoidal and frontal sinus empyemata are not infrequent.

The antrum is far more commonly affected by chronic suppuration than the other accessory cavities, a fact which is probably accounted for by its liability to infection from carious teeth, especially the second bicuspid and the first or second molar. Dental caries and chronic antral suppuration have long been looked upon as cause and effect, but some authorities hold that the relationship is by no means as frequent as has been supposed. For example, Grünwald states that out of 98 cases of antral suppuration observed by him, only one-third could in any way be associated with dental caries.

The author's experience is quite the reverse of this, for in almost every instance with which he has had to deal during the past ten years (and they number nearly 200), he has rarely seen an antral empyema unassociated with some degree of caries in the corresponding teeth. And here one must emphatically endorse the warning given by the last named author as to the importance of not overlooking the slighter forms of dental caries in antral suppuration. He says* :—" I would especially emphasise the fact that a tooth must not be considered harmless in this respect because the socket is not diseased. Infection creeps along the lymphatics of healthy bone, and a focus of infection in the crown of a tooth is by no means to be despised, for even if an empyema of the antrum be due to another cause, yet disease of the crown of a tooth is calculated to maintain such a state of irritation in the mucous membrane as may frustrate all attempts at cure."

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* *Op. cit.*

The liability of one region of the nose to infect another must not be lost sight of, and this applies to acute and chronic cases alike. A suppurating ethmoidal cell, unless there is a very free outlet for its purulent contents into the nasal cavity, will very likely infect the corresponding antrum and frontal sinus. Similarly a purulent discharge from the higher sinus may infect the ethmoidal cells and the maxillary antrum, while a chronic empyema of the last mentioned cavity may, in the reverse order, be the starting point of ethmoidal and frontal sinus suppuration.

These facts are amply borne out by clinical experience. In the treatment of fourteen cases of chronic frontal sinus empyema recently recorded by me (*Lancet*, July 14, 1900), in eleven of them more than one cavity was simultaneously affected. This may be readily accounted for when the anatomical relationships of the parts are borne in mind.

SECTION I.

EMPYEMA OF THE MAXILLARY SINUS.

Symptoms.—The commonest and perhaps the only symptom complained of by the patient is that of a "discharge from the nose," and it is generally added that this has an unpleasant smell which is variously described as "rotten," "fishy," "sickly," "like a bad tooth," &c. The pus is always fœtid when the empyema is of dental origin, which is tantamount to saying that it is rarely free from odour. The smell is unnoticed by the patient's friends though constantly in evidence to the sufferer. It will be remembered that the reverse of this occurs in atrophic or fœtid rhinitis.

The amount of the discharge varies from time to time and seems to be influenced by the condition of the general health, *e.g.*, the author has more than once heard patients affirm that when on a sea voyage the discharge would absolutely cease, only to return when the patient arrived home again.

The colour and consistency of the pus vary very much. As a general rule it is of a yellowish colour and mixes easily with water. On other occasions it may be of a brownish-yellow tint and is then exceedingly offensive. Sometimes it is discharged from the antrum by the irrigating fluid as a green, viscous, nummular mass. Finally, I have on one occasion seen the whole of the right antrum filled with a large, cheesy-like very offensive mass of caseated pus. Such cases as these correspond to the so-called cholesteatoma of the antrum.

The position of the patient's head may greatly influence the flow of pus, as will be pointed out presently when diagnosis is being discussed. Many forms of septic organisms are found in the pus of a chronic empyema and only in an acute case of intra-nasal origin would it be possible to obtain a pure cultivation.

In very many patients nasal obstruction forms a prominent symptom and such is due to the presence of polypi or chronic inflammatory swellings of the mucous membranes of the middle meatal region, as well as to a general catarrhal condition of other intra-nasal mucous membranes induced by the constant contact with pus proceeding from the sinus.

Although the nasal discharge and obstruction form two important symptoms of antral empyema, yet very frequently other symptoms may present themselves and possibly be so pronounced that the discomfort caused by them leads the patient to disregard the cardinal or early symptoms of the disease. Among such symptoms may be mentioned headache or neuralgia, various forms of indigestion, mental lassitude, and a general feeling of depression and lack of vitality.

Headache, and more especially supra-orbital neuralgia, has long been known as a symptom of antral abscess, but the fact is constantly being overlooked. The author can recall an instance of a gentleman who, having lived abroad for many years, found it necessary on his return to London to seek relief from "brow ague," as it was termed. After two and a half years of unsuccessful endeavour on the part of eminent physicians, the pain was completely and permanently relieved by the drainage of the left antrum which was the seat of a very chronic and fœtid empyema. If the headache is severe it is very natural that the patient should fail to mention the nasal discharge which may be only an inconvenience to him, and the significance of which he does not appreciate. The headache or neuralgia is often characterised by a peculiar and well marked periodicity and not uncommonly it is severe during the earlier hours of the day.

The author has never found this symptom present when there has been a free exit for the pus into the nose, and therefore does not agree with those who consider it due to inflammation of the nerves coursing in or immediately over the bony walls of the antrum. Sometimes pain may be elicited by pressure applied to the anterior wall of the antrum.

Cough is a not uncommon symptom, and this again may be worse in the morning owing to the accumulation of inspissated pus upon the pharyngeal and laryngeal mucous membranes during sleep.

It is not a matter for wonder that nausea, anorexia, and a disordered suggestion with mental lassitude, and an absence of any feeling of ***bien être*** should follow the constant swallowing of the septic contents of a chronic antral empyema. The possibility of the septic origin of many of these simpler ailments of every-day life should not be lost sight of by those who are constantly dealing with them (*vide* p. 2).

digestion /

In those rare cases of acute inflammation of the antrum, especially when there is an obstruction to the free discharge of the inflammatory exudation into the nasal cavity, the patient may complain of intense pain and a feeling of distension in the cheek, with possibly some redness, tenderness and swelling of the overlying soft parts. These may be associated with well marked pyrexia, and the usual constitutional disturbances associated with a rise of the body temperature.

Diagnosis.—It will have been noticed already that there is no symptom which is pathognomonic of antral disease and amongst those objective signs which the surgeon looks for, upon which to base his diagnosis, there are many which may be said to have only a presumptive value, and one only, the evidence of which is conclusive.

1. *The fœtid odour of the pus, complained of by the patient.*—As a general rule the pus from a chronic

maxillary empyema is fœtid, while that from a frontal sinus, uncomplicated by antral suppuration is not so. There are of course exceptions to this general rule. The patient may easily mislead the surgeon as to the source of trouble. A short while ago I was asked by an eminent laryngologist and rhinologist to examine one of his patients with a view to determining whether "the foul smell in the nose" of which the patient complained was due to any accessory sinus mischief. The most careful examination by both of us failed to detect anything abnormal in the nose, and the teeth were normal with the exception of a gold crowned first lower left molar. The supra-tonsillar fossæ contained no purulent debris. The patient was very intelligent and in no sense a neurotic, but it seemed possible that an attack of influenza a short while previously might have left him with some perversion of the olfactory sense, and from that point of view he was prescribed for, but without relief. A short while afterwards we heard that, having a little pain in the gold crowned tooth, the cap was removed giving free vent to a fœtid collection of pus, and resulting in the immediate cessation of the symptom for which he had consulted us.

2. *A purulent nasal discharge of canary-yellow pus in the middle meatus.*—If this be removed by means of a wool mop or by syringing, and the patient be instructed to lower the head while the suspected side is held uppermost for three or four minutes, a reappearance of the discharge in the meatus is very suggestive of antral empyema. Such appearances may occur in uncomplicated frontal and ethmoidal suppurations. It must, however, be carefully borne in mind that this objective symptom may be absent even in the presence of other well marked evidences of antral sup-

puration. I have, on several occasions, seen the middle meatus apparently normal when the constant smelling and swallowing of an unpleasant discharge was complained of by the patient, and only on exploration of the antrum was the source of pus discovered. This may be explained by the possibility of the patient having blown the nose violently just before submitting himself for examination, or because the antrum has been nearly emptied of its contents by a favourable (for that purpose) position of the head shortly before such an examination.

Hence, one of the commonest and most valuable evidences of antral empyema may happen to be absent at any one examination made by the surgeon where it might possibly be present a few hours later. Consequently, if the subjective symptoms of antral suppuration be well marked, one examination followed by negative results should not be considered as conclusive evidence of the absence of disease.

3. *In many cases a cushion of mucous membrane is seen between the anterior end of the middle turbinal and the outer wall of the middle meatus.*—At first sight this is liable to be mistaken for the middle turbinal, but gentle pressure upon it with a probe shows it to be a mucous membrane swelling, and this mode of examining it often causes a free flow of pus into the nose. Furthermore, the reduction of the swelling reveals the middle turbinal on its medial aspect. This at once disproves the theory that such appearances are due to "cleavage of the middle turbinal." It is impossible to pass a probe to the outerside of the mucous membrane cushion, which shows that it can be no part of the middle turbinal bone. The tumescence is in reality due to inflammation of the mucous

membrane and periosteum of the uncinate process of the ethmoid which forms the lower lip of the hiatus semilunaris. Its presence was first noted by Hartmann and emphasised by Kauffmann, who considers its presence pathognomonic of antral suppuration. Undoubtedly this is true in the great majority of cases, although the author has shown cases at the London Laryngological Society where Kauffmann's swelling has been very pronounced, but in which there had been no sign nor any history of accessory sinus suppuration. Its diagnostic value is of particular importance when it is associated with a purulent discharge in the middle meatus.

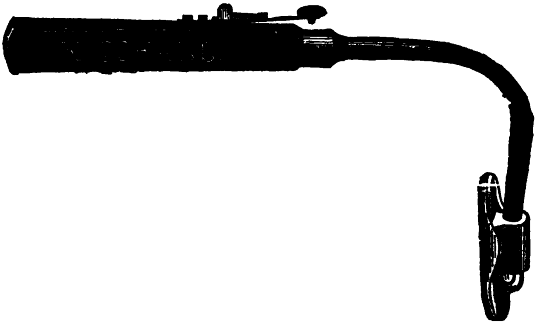
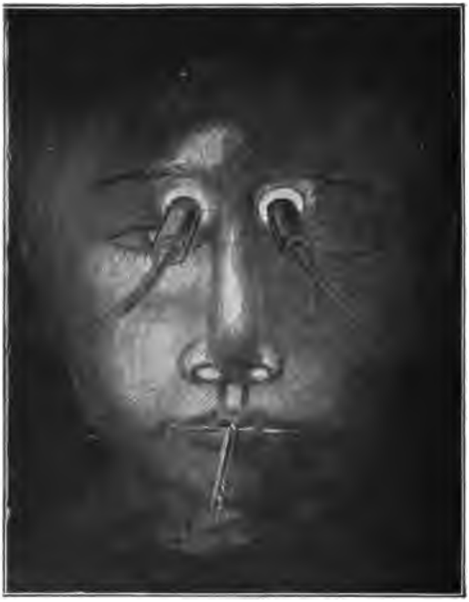


Fig. 7.—Electric Lamp for Transillumination.

4. *Transillumination of the antrum by electric light.*—This very valuable means of diagnosis was introduced by Heryng of Warsaw. A small electric lamp attached to a suitable tongue depressor (fig. 7) is introduced into the patient's mouth while his lips are kept firmly closed. The room is then darkened, or better still a black cloth, such as photographers use, is thrown over the head of the surgeon and patient in order to

PLATE II.



FAILURE OF TRANSILLUMINATION OF ANTRUM AND FRONTAL SINUS ON THE LEFT, WHILE BOTH ARE LIGHTED, AND THE PUPIL ALSO ON THE RIGHT. (From De Schweinitz and Randall's *Diseases of Ear, Nose and Throat*, vol. ii. Philadelphia, Saunders).

completely exclude the light. The electric light is now turned on and the face illuminated. If the antra be healthy, the cheeks and infra-orbital regions will be specially illuminated. It is the infra-orbital translucency which is of particular importance in this test (Plate II.). If one antrum has a thickened mucous membrane, the result of chronic suppuration, the contrast between the infra-orbital translucency on the healthy and the opacity on the diseased side will be very manifest. The opacity is probably due almost entirely to the thickened mucous membrane, because it is still present even when the pus has been washed out.

Davidson and Vohsen have pointed out that the pupil on the healthy side is seen in red light while that on the diseased side is opaque.

Garel and Burger lay stress on the fact that during transillumination the patient's subjective sensation of light is greater in the eye over the healthy antrum.

Finally, Robertson asserts that if a rhinoscopic examination be made during transillumination, the healthy nasal cavity will be considerably clearer than that which forms the inner boundary of the diseased antrum.

Unfortunately transillumination is not always to be implicitly relied upon. It may be that the bony antral wall on one side is thicker than on the other and will not be equally transilluminated. Furthermore, the presence of a solid growth (excepting polypi) within its cavity will produce a similar opacity. As illustrating the uncertainty of this method of diagnosis, I may mention a case which was demonstrated at the London Polyclinic, 22 Chenies Street, W.C., on February 22, 1901. The patient, a young man, complained of unilateral headache and slight nasal obstruction. There was a trace of muco-pus in his left nasal cavity.

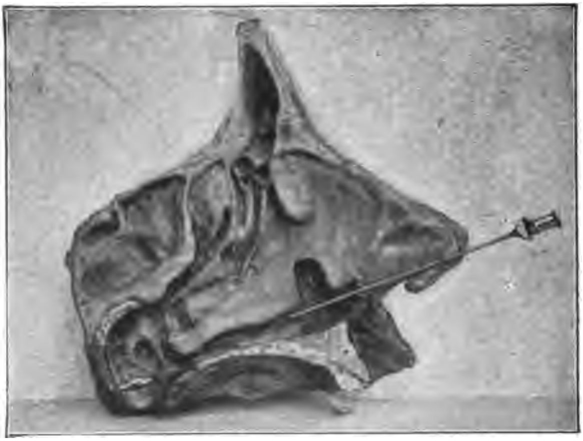
On transillumination the right cheek was brilliantly illuminated, the left much less so, and its infra-orbital region was quite opaque. No better illustration of the test could be imagined, and I fully expected and immediately proceeded to verify the diagnosis of antral empyema by exploration of the sinus. To my dismay and the disappointment of my audience the fluid returned from the antrum *quite clear*. Nevertheless, the presumptive value of transillumination is very great when unilateral opacity is associated with a chronic purulent discharge from the corresponding middle meatus.

5. *Carious teeth.*—If the first bicuspid or first or second molar tooth on the affected side be carious, it is additional evidence in favour of the purulent nasal discharge being of antral origin.

6. *Polypi and granulation tissue springing from the middle meatal region.*—These are often stated as presumptive evidence of antral disease, but it is somewhat doubtful how far this is strictly correct. Amongst the notes of my antral cases are instances in which the disease has lasted from a few months to ten years, and in some of those of longest standing there has been no sign of polypus or granulation tissue in the situation referred to. The question arises, Is not the presence of such chronic inflammatory products evidence of ethmoidal inflammation such as we find associated with the ordinary nasal polypus, such inflammation being secondary to the antral suppuration? It is the experience of the writer that the marked development of polypi and granulations in the ethmoidal region is generally associated with multiple accessory sinus suppuration, rather than an evidence or frequent concomitant of antral empyema alone.

7. *Intra-nasal puncture of the antrum.*—By this means

PLATE III.



PHOTOGRAPH OF OUTER WALL OF LEFT NASAL CAVITY, IN WHICH THE MIDDLE TURBINAL HAS BEEN REMOVED, THUS SHOWING THE GROOVE OF HIATUS SEMILUNARIS IN WHICH ARE SITUATED THE OPENINGS OF THE ANTRUM AND ANTERIOR ETHMOIDAL CELLS. A PORTION OF THE INFERIOR TURBINAL HAS BEEN REMOVED AND AN EXPLORING TROCHAR PASSED INTO THE ANTRUM. (From De Schweinitz and Randall's *Diseases of Ear, Nose and Throat*, vol. ii. Philadelphia, Saunders).

we are able to obtain absolute information as to the presence or absence of pus in the antrum. In a fairly tolerant patient, it is easy to perform the little operation after cocainising the parts where the puncture is to be made, while "gas" anæsthesia affords ample time in those patients who are intolerant of a moment's pain.

The exploration is best made by means of Lichtwitz's or Baber's trochar and cannula (figs. 8 and 9), and the puncture is made through the inner antral wall.

Some 15 per cent. cocaine solution should be applied, by means of a wool mop fastened to a probe, to the outer wall of the inferior meatus, *i.e.*, to the outer side of the inferior turbinal bone. In the course of four or five minutes, the trochar and cannula are passed in the same direction until the point of the instrument has passed about half an inch beyond the anterior end of the inferior turbinal, when the instrument is directed more externally (Plate III.). The patient's head is now held steady while the instrument is forced into the antrum through its inner bony wall. The trochar is then withdrawn, the cannula being left in position and to its proximal end is fitted a suitable syringe containing a tepid antiseptic lotion, *e.g.*, boracic lotion, gr. x. ad ℥j. On compressing the syringe the fluid passes into the

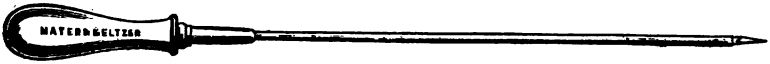


FIG. 8.—Lichtwitz's trochar and cannula.

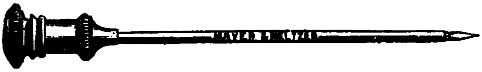


FIG. 9.—Baber's trochar and cannula.

antrum and flows from the corresponding nostril. It is at once obvious if the antrum contains pus.

This little operation is practically bloodless, it is quickly and almost painlessly performed, it does not rob the patient of a useful tooth, and the information it gives, whether it be positive or negative, is absolutely reliable.

Baber and Grünwald recommend that when the trochar is in position, instead of syringing fluid through the antrum, that an air bag, *e.g.*, Politzer's, be affixed to the trochar and air be blown into the sinus, while the surgeon carefully watches the region of the middle meatus for the escape of bubbles of purulent discharge.

There seems no special advantage in this method, and one can scarcely credit the statement of the last mentioned authority that air insufflation will often detect small quantities of pus which would not be recognised in the fluid used for irrigation, and which may even fail to be carried out of the antrum by the escaping lotion.

As will be more particularly pointed out later on, the presence of pus in the antrum may be associated with suppurative lesions in the other accessory sinuses.

Treatment.—Instances of acute antral suppuration rarely come under the surgeon's notice. The symptoms are often mistaken for those of a severe cold, with face-ache or neuralgia, but when the contents of the sinus are retained under tension active interference may be demanded. In the milder cases warm fomentations to the affected cheek, and inhalations of mentholised steam (*vide* Acute Inflammation of the Frontal Sinus) may afford the necessary relief. In the severer cases where the antral walls are distended, the cheek swollen and the pain severe, it is often sufficient to remove a carious tooth, perforate the alveolus and gently syringe out the purulent contents with a warm antiseptic lotion.

With such treatment continued for a few days, many of the acute cases recover quickly and completely.

If the empyema be chronic the aim of the surgeon will be directed towards:—(1) Removing the source of septic infection of the antral cavity, and (2) Restoring the lining mucous membrane of the sinus to a normal condition. To these ends some form of effectual drainage of the antrum will be necessary, while frequent irrigation with suitable antiseptic fluids will hasten the return of the lining membrane to a healthy condition. In certain chronic cases where such means fail to produce a cure, more radical methods of dealing with the disease may be necessary.

The various methods of treatment may be considered under the following heads:—

1. Perforation of the floor of the antrum through the alveolus.

2. Perforation of the anterior wall of the antrum in the canine fossa.

3. Establishment of a free communication between the antrum and the inferior meatus of the nose.

4. A radical operation involving removal of a considerable portion of the anterior antral wall, curettage of the diseased mucous membrane, and the establishment of a free communication between the antrum and the nasal cavity.

Considerable difference of opinion exists as to what is the best course to pursue in any given case, and it is a difficulty which possibly is enhanced by an endeavour, which is often made, to prescribe a certain form of treatment for every patient irrespective of the particular needs of each individual case.

If the surgeon will place himself in the patient's position and advise the latter to submit to a line of treatment which, as a medical man, he would himself be prepared to undergo, the author believes that the most satisfactory results (both from the patient's and surgeon's point of view) would be attained by the adoption of methods carried out upon the following lines.

1. THE METHOD OF ALVEOLAR PUNCTURE.

Under nitrous oxide anæsthesia all carious teeth on the side corresponding to the diseased antrum should be removed, because it is impossible to say which of them may be the cause of mischief. It has already been pointed out that the first two molars are pre-eminently likely to set up antral suppuration when they become carious. The antrum should then be punctured through the alveolar socket by means of an antral perforator (fig. 10). The best site for the

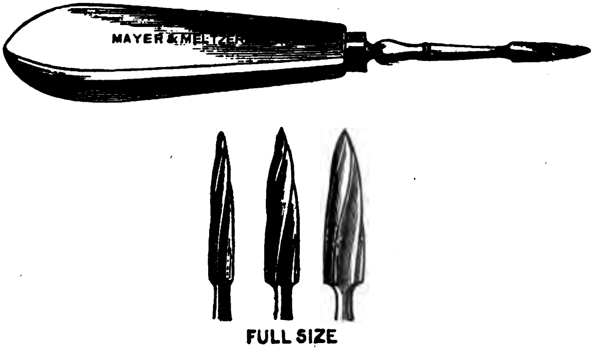


FIG. 10.—England's antrum drill.

perforation is about the position of the first molar tooth, because in this situation it is easier for the patient to carry out the after treatment than when the opening is made further back.

Through the perforation thus made the antrum should be washed out with some antiseptic lotion such as boracic acid, gr. xv. ad ℥j., carbolic lotion, 1 in 60, or even a solution of common salt, ʒj. ad Oss.

In order to provide for effectual drainage some form of drainage tube becomes necessary. Of such there are many different kinds, but Ellis's silver wire tube (fig. 11) is under ordinary circumstances as useful as any and more economical than most. Its calibre should be about the size of crow quill, and in spite of the fact that it affords a communication between the sinus and the mouth, it will be often found that cases progress very satisfactorily when treated in this manner.

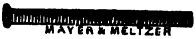


FIG. 11.—Ellis's spiral drainage tube (half natural size).

Some surgeons prefer a gilt tube fixed by hooks to the adjacent teeth and fitted with a metal plug which can be removed when the antrum is to be irrigated.

In one instance where economy had to be considered, a dentist made for a patient of mine, a vulcanite plate supporting an upright solid plug, the whole being fixed to the adjacent teeth by means of hooks.

It is important that the drainage tube should not unduly project beyond the level of the floor of the antrum or its very object (the drainage of the antral cavity) will be defeated. The correct length may be determined by bending over the end of a fine probe, passing it into the sinus, hooking the curved portion over the upper edge of the bony canal, marking it where it emerges at the level of the gum, and making the drainage tube a corresponding length. Another advantage of the wire drainage tube is that its roughness enables the soft tissues to retain it without fear of its slipping into the mouth during sleep.

The tube having been inserted, the patient is instructed to leave it in for twenty-four hours and then to remove it for the purpose of irrigating the antrum.

This is best carried out by means of a Higginson's enema syringe the usual terminal of which is replaced by a small silver tube, straight or curved, which is passed into the alveolar perforation previously occupied by the drainage tube. When the ball of the syringe is compressed the fluid injected into the antrum should pass freely from the corresponding nostril.

With regard to the lotion used, some advise warm salt solution (ʒj. ad Oss.), others Condy's fluid, or an alkaline antiseptic wash (p. 26), creolin (1 in 1000), sulphate of zinc (gr. ii. ad ℥j.), &c. As a matter of fact it is the thorough irrigation which is of most importance, the antiseptic used being almost a secondary matter. A frequent change of lotion is often of great value in hastening the cure of the suppuration.

At first, the antrum should be syringed twice daily, morning and evening, but when the discharge lessens the irrigation may be practised once a day, then on alternate days, and so on, until an interval of a week or ten days has elapsed between consecutive irrigations. If then, no pus returns with the fluid, the drainage tube may be removed and the case considered as cured.

The advantages of this method are:—

a. It drains the antrum from the lowest point, an important factor in the treatment of any suppurating cavity.

b. The treatment may, after one or two visits to the surgeon, be carried out by the patient in his own home.

It should ever be borne in mind that with the alveolar method of treatment, the progress towards cure depends in great part on the punctilious care with which the syringing is carried out by the patient. Hence it should be the aim of the surgeon to see his patient provided with the simplest efficient apparatus possible, that he thoroughly understands how to use it, and that he be duly impressed with the importance of regularly and thoroughly cleansing the antral cavity.

If such details are attended to, it will be of comparatively minor importance what form of drainage tube or irrigating fluid be used. Should the patient at any time find himself without his syringe, he may be able to irrigate the antrum by holding the fluid in his cheek, inclining the head so that the diseased antrum is lowermost, and then by compressing the fluid between the air posteriorly and the buccinator muscle in front, the fluid will be forced into the antrum and out of the corresponding nostril

ACCIDENTS AND DIFFICULTIES.

a. It is sometimes difficult to tap the antrum through the alveolus. Such may be the case when the sinus is small and situated high up in the maxillary bone. Under these circumstances an intra-nasal opening would be preferable.

b. On one occasion a patient of the author's bled very profusely for some ten or fifteen minutes after the puncture. The hæmorrhage was arterial and a measured half pint of blood quickly escaped from the nostril. The patient, who was a weakly, anæmic man, became very faint and it was necessary, in order to check the hæmorrhage, to pack a long strip of antiseptic gauze tightly into the antrum and into the corresponding nasal fossa. It is probable that some aberrant artery crossed the line of puncture in the floor of the antrum.

Prognosis.—In connection with this mode of treatment, the patient will often ask the question, "How long shall I have to continue the treatment before being cured?" To this it is practically impossible to give anything like a definite answer, because we are unable, without actual inspection, to determine the condition of the lining mucous membrane and the bony walls of the antrum. If the membrane be degenerated into a polypoid condition and still more so if a portion of the bony wall be carious, it is inconceivable that irrigation alone will cure the suppuration.

As a general rule, cases arising by infection from the nose, those of a few week's duration and those in which the antral suppuration is not associated with similar disease in neighbouring accessory cavities, are more likely to respond to alveolar drainage than where the antral disease is of long standing, of dental origin and associated with empyemata of the adjoining sinuses.

Experience would lead me to the conclusion that the chronicity of the suppuration, taken alone, is of very little value in prognosis. A long standing empyema may be cured by a few irrigations; a more recent one may resist the most careful, punctilious, and prolonged syringing.

I should be inclined to lay most stress upon the appearances seen in the middle meatus. If this region be free from polypi or granulations, even if the antral disease be of long standing, the prognosis of cure by the alveolar method of treatment is considerably more hopeful than when such evidences of chronic inflammation exist.

Such appearances more often represent the outward and visible signs of a similarly degenerated antral mucous membrane, often associated with ethmoidal disease, a combination which will only respond to severer methods of treatment.

It is this uncertainty of prognosis which has led many surgeons to propose the radical operation (*vide infra*) at the commencement of treatment.

The writer cannot agree with this view of the matter for it is well known to all surgeons that the alveolar method will cure many cases of antral suppuration of recent and even long standing, and every patient should have the advantage of this knowledge.

In nearly every instance he will select to try the simpler means first—we ourselves should do so—and it is not improbable that the result will be satisfactory. If it should not be so, the discharge will almost certainly be lessened and robbed of its fœtor, and the patient will at least be placed in a much more comfortable condition.

If, finally, after two or three months treatment the patient desires to be entirely rid of the discharge, then he may be quite justifiably recommended to submit to a more radical procedure, which offers the only hope of success and which, if skilfully carried out, will in all probability remove the last trace of the discharge.

The surgeon will have the less hesitation in advising this course because he will know that a chronic antral suppuration if left to itself tends sooner or later to infect the neighbouring sinuses and to induce lesions which may not be altogether free from risk to the patient's life.

An instructive illustration of this complication has recently occurred in a patient of mine whose antra have been drained for the last seven years by the alveolar method. In spite of constant change of lotions and unremitting care on the patient's part, the discharge has never ceased. After a few months' trial of this method of treatment a radical operation was advised, but the relief he experienced from the drainage and daily irrigation induced him to decide against any further procedures. He said, "The inconvenience is so slight and the discharge so much better, that I do not mind if I have to continue this small addition to my toilet for the rest of my life."

When last he presented himself to me (March, 1901) he was suffering from severe frontal headache on the right side, slight œdema of the right upper eyelid and general symptoms of malaise. Examination of the right nasal cavity showed well marked ethmoidal suppuration, and there was little difficulty in washing out a collection of pus from his frontal sinus.

2. Puncture through the Canine Fossa.

This method is one which is rarely used and would only be contemplated when the empyema was unassociated with dental caries. Under these circumstances it would be inadvisable to remove a sound tooth, and hence puncture through the canine fossa may occasionally be necessary.

The same perforator is used as has already been described. The disadvantages of this method are:—

1. That the antrum is not drained from its lowest point.
2. There is generally considerable swelling of the loose mucous membrane between the gum and upper lip and in this the head of the tube is apt to be lost.
3. The patient always experiences some difficulty in syringing the antrum through this opening.

3. PERFORATION THROUGH THE INFERIOR MEATUS OF THE NOSE. (Mikulicz's method).

This operation is best carried out under a general anæsthetic, and like the preceding method is mainly of value when it is undesirable to sacrifice a sound tooth.

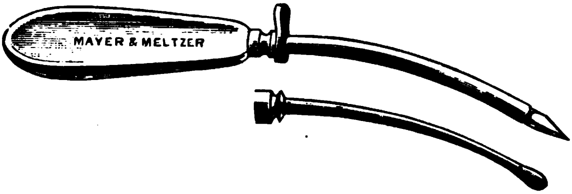


FIG. 12.— Krause's trochar and cannula.

The opening is best made by means of Krause's trochar and cannula (fig. 12) and it should be situated about one inch behind the anterior end of the inferior turbinate. The proceeding is rendered easier for the surgeon, and the after-treatment much easier for the patient, if a week previously the anterior half of the inferior turbinal be removed.

The opening into the antrum should be at least the size of a threepenny bit, otherwise cicatricial narrowing of the aperture will soon render the passage of the smallest cannula a matter of difficulty to both surgeon and patient.

The advantages claimed for this method are:—

1. That the antrum is drained from its lowest point.

2. There is no risk of septic matter entering the antrum from the mouth.

3. It does not necessitate the removal of a sound tooth.

Its disadvantages are:—

1. There is a great tendency for the aperture to close unless a large one is made.

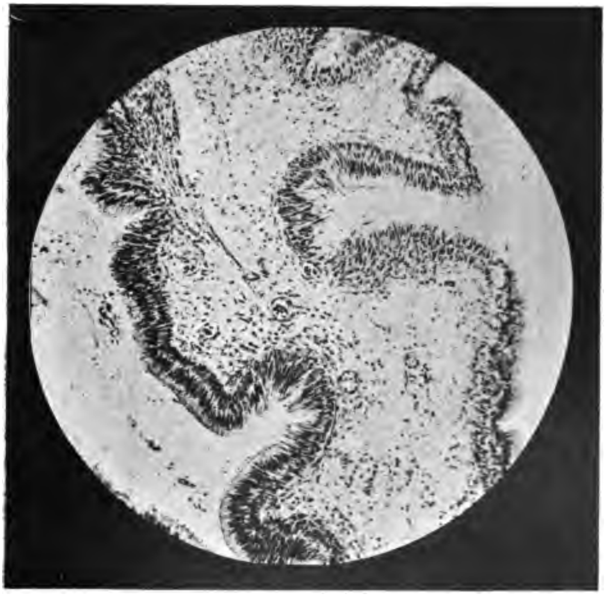
2. Patients often find considerable difficulty in carrying out the after-treatment.

3. In many narrow nostrils the passing of the catheter for irrigation gives rise to an amount of discomfort which may encourage the patient to discontinue treatment.

Garel and Bronner have advocated syringing the antrum through its natural ostium by means of a special cannula. The author feels certain that this method must be absolutely impossible for the majority of patients, and is convinced that irrigation *through* a suppurating cavity is far more likely to cleanse it than imperfect injections into its upper end. Finally, the natural ostium is very badly situated for drainage purposes.

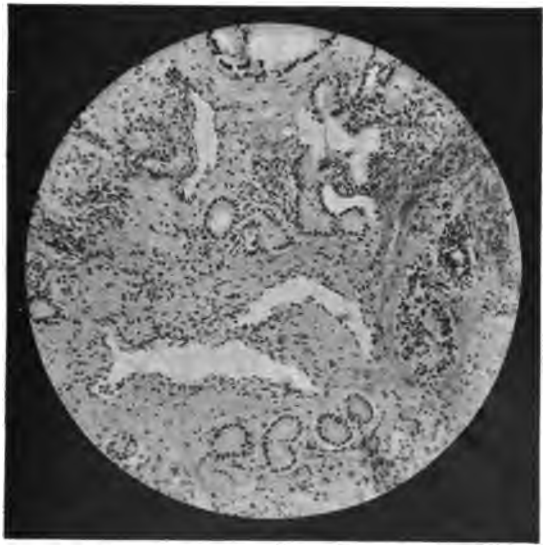
Whatever method of treatment be selected it is needless to say that suitable intra-nasal treatment should be simultaneously carried out; hence polypi, granulations or a swollen anterior end of the middle turbinal should be removed from the middle meatal region, while the various forms of hypertrophic rhinitis demand appropriate treatment by means of alkaline douches, the snare, or the judicious application of the galvano-cautery.

PLATE IV.



MICROSCOPIC SECTION OF MUCOUS MEMBRANE WHICH HAS UNDERGONE POLYPOID DEGENERATION, FROM A CASE OF CHRONIC EMPYEMA OF THE MAXILLARY ANTRUM.

PLATE V.



MICROSCOPIC SECTION OF MUCOUS MEMBRANE FROM A CASE OF CHRONIC ANTRAL SUPPURATION SHOWING THE THICKENED SUB-EPITHELIAL TISSUE IN WHICH PORTIONS OF THE SUB-MUCOUS GLANDS ARE SEEN IN SECTION.

4. A RADICAL OPERATION CONSISTING OF CURETTAGE OF THE ANTRAL CAVITY THROUGH A LARGE OPENING IN THE CANINE FOSSA, TOGETHER WITH A COUNTER OPENING IN THE INFERIOR NASAL MEATUS.

This method of dealing with chronic antral suppuration should be reserved for those cases which fail to get well after a fair trial by the simpler means of alveolar drainage already described.

Such cases undoubtedly exist, and when the cause of the persistence of the suppuration is investigated, it will be readily understood why irrigation and drainage, however persistently and effectually carried out, offer little prospect of success.

Under such circumstances it will be seen that the mucous membrane of the antrum has undergone a polypoid degeneration, and the interstices of the outgrowths form ideal conditions for the harbouring and multiplication of various septic organisms which it is impossible to effectually destroy by means of simple syringing.

The accompanying plates, for the loan of which I am indebted to Mr. Hovell and Mr. Eve,* illustrate the microscopical appearances of the chronically inflamed mucous membrane. The antral cavity is often filled with the hypertrophied mucosa, the surface of which may be "highly papillary and plicated" and covered with a columnar epithelium. (Plate IV.).

In other cases, of longer standing, the sub-epithelial connective tissue is much thickened while the illustrations exhibit, here and there, sections through the hypertrophied mucous glands. (Plate V.).

* *Clinical Society's Transactions*, vol. xxxii., 1899.

Before proceeding to describe the radical operation it is well to bear in mind that the antrum may be merely a reservoir of pus, the source of which lies in one of the higher accessory cavities; it would obviously be useless under such circumstances to operate upon the maxillary sinus alone. The author lays stress upon this fact because he has known instances where, after the operation has been performed, the recurrence of suppuration, (in reality due to re-infection from the fronto-ethmoidal sinuses) has been placed to the discredit of the means adopted for its cure, rather than to the faulty diagnosis of the surgeon.

The radical operation as first described by Caldwell, and introduced into this country by Scanes Spicer, and into France by Luc (Paris), may be described as follows:—Under a general anæsthetic an incision is made along the gingivo-labial fold over the anterior antral wall, the posterior end of the incision being on a level with the malar process of the superior maxillary bone (opposite the first molar tooth) the anterior terminating opposite the canine tooth.

The soft parts and periosteum are retracted upwards until the anterior antral wall is well exposed over an area the size of a sixpence.

It is well to place a sponge between the cheek and the teeth to prevent the flow of blood into the throat.

By means of gouge and mallet an area of bone is removed sufficient to admit the tip of the index finger. The opening should be level with the floor of the sinus inferiorly, and extend on the inner side to the junction of the anterior with the inner wall of the antrum. In this way easy access is gained for the establishment of the naso-antral opening.

The removal of bone is generally followed by a discharge of pus and the projection into the bony breech of the polypoid mucous membrane filling the sinus cavity.

The diseased membrane is at once curetted, the best instrument for the purpose being a Mayer's ring knife (fig. 13). Two or three sizes should be at hand, and it will be an advantage if they have a somewhat malleable shaft so that the terminal ring may be bent to a more or less obtuse angle. Such a curve is necessary in order to thoroughly curette the anterior walls and other parts of the sinus which are inaccessible to a straight instrument.

The curetting is usually followed by free hæmorrhage, but this may soon be checked if the surgeon has close at hand a number of strips of dry antiseptic gauze with which to pack the antral cavity.

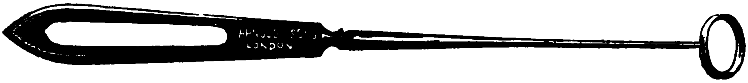


FIG. 13.—Mayer's ring knife.

It must be the object of the surgeon to remove every particle of diseased mucous membrane from the sinus, and to this end the cavity must be constantly dried with gauze strips and then illuminated by indirect light from a forehead mirror, or by means of an electrophore worn upon the forehead.

The parts which need especial care in curetting are the hollow concavity of the malar bone within the antrum, the ethmoidal region of the sinus and the floor in the neighbourhood of the molar roots.

Being satisfied that all the diseased mucous membrane has been removed the sinus should be swabbed out with chloride of zinc, gr. 40 ad ℥j., or even pure carbolic acid, and the naso-antral opening then proceeded with.

This opening, made by means of gouge and mallet, should be on a level with the floor of the antrum, and the ease with which the communication is made is considerably enhanced if the original bony breech in the canine fossa be made to extend well inwards to the level of the canine tooth.

Having removed a small plate of bone from the naso-antral wall, it is easy to enlarge the opening with burrs, and it cannot be too strongly impressed upon those who are inexperienced in this operation that the after comfort of the patient and the ease with which he can carry out the necessary irrigation, will depend on the size of the naso-antral opening which the surgeon makes. A hole which will admit the tip of the little finger at the time of operation will almost certainly cicatrise, in the course of two or three weeks, to such an extent that the passage through it of an Eustachian catheter will be a matter of difficulty. Hence one should always make a perforation which will easily admit the tip of the index finger. It will much facilitate matters if the anterior half of the inferior turbinal be removed a week prior to the radical operation.

The sinus cavity is finally packed with iodoform gauze, the proximal end of which is passed through the naso-antral opening and out of the corresponding nostril, close to which it is cut off. The soft parts should then be brought together with one or two fine catgut sutures, for the passing of which a small curved needle held in a needle holder will be of great assistance.

The patient should be confined to liquid food for three days, and then if the wound be progressing satisfactorily semi-solid nourishment may be taken.

On the third day following the operation the gauze should be removed from the antrum by drawing upon the end projecting from the nostril. No re-insertion of the dressing is necessary, even if it were possible, but for two or three weeks the antrum should be daily irrigated with boracic lotion in order to remove any serous accumulations therefrom, and also to bring away any of the little crusts which tend to form around the naso-antral opening.

An Eustachian catheter fitted to a Higginson's syringe makes an excellent instrument for purposes of irrigation.

There is sometimes a painful swelling of the cheek for two or three days following the operation, but it may be greatly relieved by constant applications of hot glycerine and belladonna fomentations.

Epiphora is a little complication which is not, as a rule, of more than a week's duration; it arises from obstruction of the lower end of the lacrymal duct due to traumatic inflammation of the mucous membrane around the artificial naso-antral opening.

The operation as above described is a modification of Kuster's method. He proposed an opening in the canine fossa, curettage of the diseased contents and packing the cavity with antiseptic gauze. The after-treatment consisted of one or two subsequent packings, followed by irrigations through the bucco-antral opening until the discharge ceased and the patient was cured. There was thus a considerable risk of the sinus becoming re-infected from the mouth during the period following the operation, added to which there was the not infrequent occurrence of a permanent bucco-antral fistula, which in many cases demanded a further plastic operation for its cure.

These objections are entirely avoided by the operation which has been described in detail above, and which the experience of the writer would lead him to recommend in all cases in which suppuration continues after a fair trial has been made by the alveolar method.

JANSEN'S OPERATION.

This consists in removing the entire anterior bony wall of the antrum. One can scarcely conceive of any case of chronic antral empyema needing so drastic a procedure, and involving as it does the disfigurement of a sunken cheek. If the radical operation previously described fails to cure, the writer would advise the surgeon to open up the wound again, make a larger opening into the antral cavity, and carefully search for areas of diseased membrane which he probably failed to discover and remove in his first operation. Should the suppuration still persist it is not improbable that certain of the ethmoidal cells are diseased and serve to re-infect the antral cavity.

SECTION II.

ETHMOIDAL SUPPURATION.

Before dealing in detail with ethmoidal suppuration, it may be well to briefly consider some of the anatomical features of this bone.

As already stated the cells composing the lateral mass of the ethmoid may be divided into two groups, the anterior and posterior. The former, situated in front of, and below, the line of attachment of the middle turbinal, open by one or more apertures into the groove of the hiatus semilunaris, in front of, and above, the orifice of the antrum.

The posterior group, fewer in number than the anterior cells, open into the superior meatus, and their "ostia" are larger than those of the anterior group, and for this reason are possibly less liable to retain inflammatory products.

Among the anterior group of cells are two which claim especial attention, viz., the "bulla ethmoidalis" and the frontal bulla.

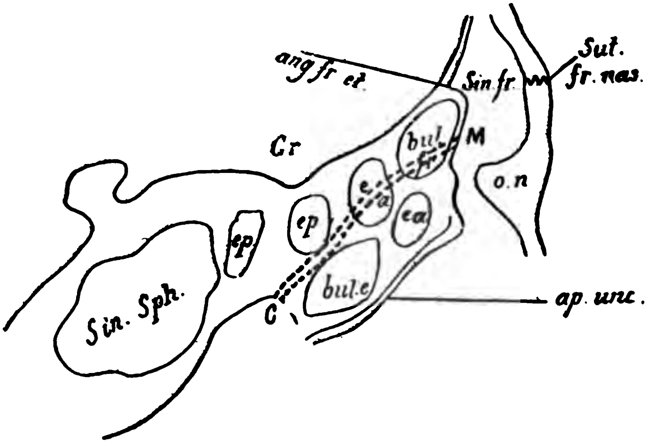


FIG 14.—Antero-posterior section of the ethmoidal labyrinth (diagrammatic). (Luc). *C. r.* floor of anterior cerebral fossa; *Ang. fr. et.* fronto-ethmoidal angle; *Sin. fr.* frontal sinus; *bul. fr.* frontal bulla; *M. C.* dotted line indicating attachment of the middle turbinal bone; *e. a.* anterior ethmoidal cells; *bul. e.* ethmoidal bulla; *ap. unc.* uncinate process; *e. p.* posterior ethmoidal cells; *Sin. Sph.* sphenoidal sinus.

The ethmoidal bulla (fig. 14)[*] is situated in the concavity of the hiatus semilunaris and may indeed be said to form the upper lip of that depression. It is the largest of the anterior group of cells, and according to Luc opens by an enlarged orifice on its upper face at the bottom of the groove which separates it (the cell) from the attachment of the middle turbinal. It will at once be obvious how inefficiently such an aperture would function for purposes of drainage.

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[*] The author is indebted for the loan of this and the following clichés to his friend Dr. Henry Luc (Paris).

This cell is sometimes very enlarged, but it is not often seen by anterior rhinoscopy because it is hidden by the anterior end of the middle turbinal bone.

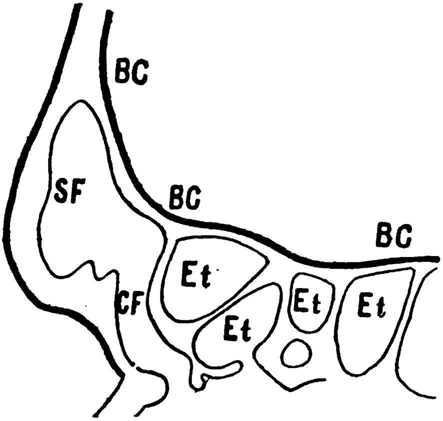

FIG. 15.—BC. floor of anterior cerebral fossa; SF. frontal sinus; CF. fronto-nasal canal; Et. ethmoidal cells.

The frontal bulla (Lothrop) is best illustrated by the accompanying diagram (fig. 15), in which it will be seen forming a projection at the lower part of the posterior wall of the frontal sinus (also fig. 14, *bul. fr.*).

Posteriorly the lateral mass of the ethmoid is in close contact with the sphenoid, and anteriorly it may be said to communicate with the frontal sinus, in fact according to Hartmann's researches, the frontal sinus is developed by a budding upwards of an ethmoidal cell into the lower part of the frontal bone.

Furthermore, the fact that the anterior cells open into the hiatus semilunaris, in front of and above the antral ostium, and that the upper and inner antral wall is largely composed of the ethmoidal bone (anterior cells and uncinate process) readily explains the frequent association of these sinuses in the same morbid process.

The intermediate position of the ethmoidal cells, and their labyrinthine structure render it obvious why they are so frequently associated in disease with the frontal, sphenoidal and antral sinuses.

If they (ethmoidal cells) are primarily affected the risk to the other cavities is great, and vice versa, primary infection of any one other sinus is scarcely likely, if the inflammation be long continued, to leave the ethmoidal cells free from infection. It is for these reasons that suppuration is rarely found limited to the ethmoidal region for any length of time.

The ætiology of ethmoidal suppuration has already been dwelt upon (p. 39); suffice it to say once more that many cases seem to date from an attack of influenza, others from a severe cold, many are secondary to chronic antral empyema, while a very few have been secondary to orbital suppuration, the pus having found its way into the nose through the ethmoidal cells.

The unskilful use of the galvano-cautery, careless application of strong acids, and incomplete or badly executed operations in this region, will account for some cases of ethmoidal suppuration.

Morbid Anatomy.—Although we are only here concerned with the diseases of the ethmoid characterised by a purulent discharge, yet it may be well to point out that in the ethmoidal region we may meet with all degrees of inflammation of bone and periosteum with which the surgeon is familiar in other regions of the body. Hence, it is not uncommon to find evidences of periostitis, hyperostosis, and rarefying osteitis, less commonly caries and still more rarely necrosis.

Caries and necrosis are practically always associated with suppuration.

Coincident with such inflammatory changes in the bone are corresponding degrees of inflammation in the overlying mucous membrane and muco-periosteum. In the milder cases there may be a slight hypertrophy of the tissues; in those in which the inflammation is severe or prolonged, and especially in the suppurative cases, the mucous membrane becomes so inflamed and œdematous that in due course the typical nasal polypus is the result.

To all such forms of inflammation the term ethmoiditis may conveniently be applied, and it should be understood, once and for all, that inflammation of bone and mucous membrane in the nose differs in no way from similar inflammation in other parts of the body, except in so far as its results are modified by the peculiar physical conditions existing within the nasal cavities.

This emphasis is necessary in order to dispel that atmosphere of mystery with which the writings of Woakes has surrounded this subject, but to whom, it is only fair to say, rhinologists are indebted for having drawn attention to the existence and importance of those changes in the bone which are summed up in the term ethmoiditis.

In discussing the symptoms, diagnosis and treatment of ethmoidal suppuration, I shall adopt the classification introduced by Grünwald who divides his cases into:—

1. Closed empyemata, *i.e.*, those which do not communicate with the nasal cavities or the exterior.

2. Open empyemata, *i.e.*, those which do communicate with the exterior.

1. CLOSED ETHMOIDAL EMPYEMA.

One of the anterior cells of the middle turbinal is most commonly affected, and the empyema probably results from septic infection of the inflammatory exudation contained in the cell, which latter was possibly the result of an acute catarrh.

In two cases which have come under my care, nasal obstruction with slight aching over the bridge of the nose have been the main symptoms complained of by the patients.

Both occurred in females, and in one the distended middle turbinal nearly reached to the floor of the nose, it was of a dull greyish-red colour and gave the sensation of egg-shell crackling when pressed on by a probe. In the second case, the anterior end of the middle turbinal was bright red, much distended and it was with difficulty that a probe could be passed between the tumour and the septum.

Treatment.—If it be possible the middle turbinal should be divided along the anterior half of its attachment to the outer wall of the nose, by means of Grünwald's forceps (fig. 16), after which the semi-detached portion may be easily removed by means of a wire snare.

In the first case referred to the contents of the bony cyst were bright green, very liquid pus; the second consisted of muco-pus and the walls of the distended cell were lined with a polypoid mucous membrane.

In each patient the removal of the cysts was followed by complete relief of all symptoms.

2. Open Ethmoidal Empyema.

Symptoms.—In addition to the purulent discharge from the nose, pain may or may not be present, it may be localised about the root of the nose, in and around the eye, or in the supra-orbital or temporal region. Its presence or absence seems, like antral pain, to depend upon the freedom with which the pus can escape into the nose. Sometimes it is not so much pain as a "feeling of tightness over the bridge of the nose" which is complained of.

Grünwald lays stress upon pain induced by pressure over the lacrymal bone as being very characteristic of ethmoidal inflammation.

In many cases of long standing, nasal obstruction, due to the formation of polypi, may be the symptom which causes the patient most inconvenience.

As in antral and frontal sinus suppuration, so in ethmoidal empyema, the patient may constantly feel "under a cloud" and suffer from all those forms of mental depression which have been detailed when dealing with empyema of the antrum.

The result of long continued ethmoiditis is sometimes seen in the enormous and unsightly increase in the breadth of the upper region of the nose. Several such cases have been shown at the meetings of the London Laryngological Society during recent years, although not all of them have been accompanied by suppuration.

The objective symptoms revealed by anterior rhinoscopy will depend upon the extent and chronicity of the disease. If only one or two cells are affected we may see no more than a trace of pus in the middle meatus and possibly a few granulations in the same position.

With more extensive disease it is not uncommon to find the upper and outer regions of the nose occluded by polypi or large granulations which are bathed in pus. If sufficient of these growths be removed so that the middle meatus can be examined, this region will often be seen to be abnormally wide and filled with chronic inflammatory growths, while the middle turbinal, itself suffering from the ravages of a rarefying osteitis, may be softened, atrophied, and hanging loosely from its attachment to the upper and outer wall of the nose.

Oozing from amongst these chronic inflammatory products will be drops of pus which, as a rule, are non-fœtid.

The chronic inflammation is not limited to the soft structures alone, for if a probe be passed amongst the granulations it will at once impinge upon small areas of exposed bone which easily break down before the pressure of the probe, and with little difficulty small spicules of bone may be removed from the diseased areas.

The extension of the disease may not be limited to the ethmoidal cells, but may pass to neighbouring regions, *e.g.*, the eye, cranial cavity, frontal, maxillary, or sphenoidal sinuses.

It has already been stated that caries and necrosis of the ethmoid (using those terms in the sense in which they are understood when discussing inflammation of bone generally) are practically always accompanied by suppuration and other evidences of inflammation. It would have been scarcely necessary to emphasise this point had not Woakes stated that dead bone or "necrosing ethmoiditis" is very common in patients who do not exhibit the usual symptoms of diseased bone in the nose. If such a principle be once admitted it would be extremely interesting to know in what lies the criterion of a healthy nose.

The writer does not believe that necrosed bone ever exists in the nasal cavities without suppuration, because with ample opportunities of, and every desire for, observing such an occurrence, he has failed to see a single instance during the past ten years.

There can be little doubt that this opinion is maintained by the vast majority of rhinologists at home and abroad.

How then are we to explain the views of the few who share the opinions promulgated by the last named observer?

Having had many opportunities of seeing their practice and attending demonstrations on the subject, I have long been convinced that the supporters of Woakes' theory have been entirely led astray by examining the middle meatal region with too sharp an instrument—it would be mere affectation to call it a probe. Over and over again have I seen "bare bone" demonstrated by this method where the patient's nose was absolutely normal, and in whom there was possibly no complaint of any nasal symptoms whatever, many patients, for example, having sought advice for ear symptoms, *e.g.*, deafness, tinnitus, &c.

The muco-periosteum in the middle meatal region covering the anterior ethmoidal cells is very thin, especially just below the attachment of the middle turbinal, and any instrument sharper than a probe will easily pierce this tissue and impinge on the underlying bone.

If the student will use a fair surgical probe, he will never discover "bare bone" unless it has a genuine existence, and under such circumstances it will be associated with suppuration and probably other well marked evidences of inflammation, such as granulations and inflamed mucous membrane.

Suppuration of the anterior ethmoidal cells is generally evidenced by pus in the middle meatus, whereas when the posterior group is affected the purulent discharge may be seen by posterior rhinoscopy in the superior meatus, covering the posterior end of the middle turbinal or upon the posterior pharyngeal wall. Sometimes it passes forwards between the septum and the middle turbinal.

Too much stress must not be laid upon the position of the discharge, because of the varying factors which determine the direction of the flow in each case, *e.g.*, position of the head, blocking of the middle meatus by the swollen end of the middle turbinal, presence of polypi, &c.

Should the disease find its way towards the orbit by perforation of the orbital plate of the ethmoid or the lacrymal bone, a fluctuating or tender brawny swelling may be seen affecting the tissues over the internal angle of the orbit and the region above the internal palpebral ligament. If the drainage of pus into the nose be obstructed the orbital swelling may increase and force the eyeball downwards and outwards, or the skin may give way so that a fistula leading into the diseased bony labyrinth results.

In other cases the pus may burrow below the internal palpebral ligament and point somewhere along the infra-orbital ridge or upper part of the cheek.

As a general rule the contents of the orbit are protected from infection by the orbital capsule, and excepting for the displacement referred to no permanent harm to the eye results.

As will be stated later on, the sphenoidal sinus is liable to infection when the posterior ethmoidal cells are diseased, while the risk of suppuration occurring in the frontal and maxillary sinuses has already been dwelt upon.

Diagnosis.—This will be mainly deduced from the objective symptoms already dwelt upon. The difficulty will be for the surgeon to determine whether other accessory sinuses are coincidently diseased.

Transillumination and exploration will aid us in determining suppuration of the antrum, but it may be impossible to exclude empyema of the frontal sinus, neither is it of vast importance that we should do so, because careful treatment of the ethmoidal disease is a necessary preliminary to the cure of the frontal empyema should the latter exist and eventually demand treatment (*vide infra*).

Treatment.—The nasal cavities should be first cleansed with an alkaline antiseptic spray (p. 26) or douche.

A 10 to 15 per cent. solution of cocaine is then applied to any polypi or prominent granulations growing from the middle meatal region, and in from three to five minutes these should be removed by means of a cold wire snare, or Grünwald's forceps.

To gain access to the anterior ethmoidal cells it is practically always necessary to remove at least the anterior half of the middle turbinal (*vide* p. 73). This at once will provide an excellent view of the field of operation and the extent of the disease, while it has the additional advantage of removing an obstruction to free drainage from the diseased cells of the outer wall of the meatus. The operation may be easily carried out under cocaine anæsthesia, unless the patient is very nervous, when a general anæsthetic may be employed. The advantage of cocaine is that during the operation, the patient is sitting in the position in which the surgeon is accustomed to examine the nose, and in which the various relationships of intra-nasal structures are familiar to him.

The hæmorrhage is rarely excessive, and may be quickly checked by applying to the wounded parts some strips of gauze moistened with a freshly made solution of hydrogen peroxide.

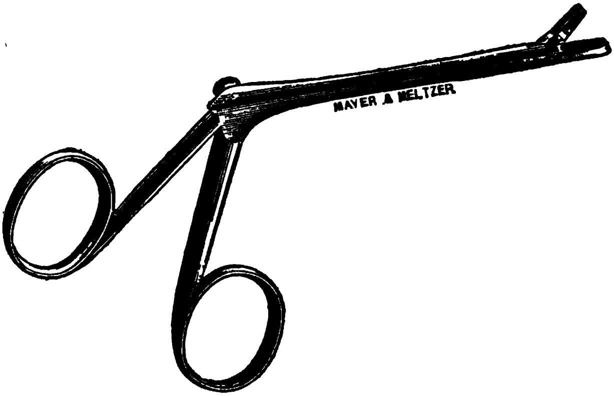

FIG. 16.—Grünwald's forceps.

After an interval of a few days the diseased anterior cells should be dealt with, and all granulations and diseased bone removed as far as may be possible. Two instruments are especially useful for this purpose (*a*) Mayer's ring curette (fig. 13) and (*b*) Grünwald's forceps (fig. 16). Where the disease is limited the latter instrument will suffice, and cocaine anæsthesia is usually sufficient, but when extensive suppuration and caries are present, I prefer to use a Mayer's ring knife, or suitably curved sharp spoons, the patient being under a general anæsthetic.

The advantage of the latter method is that the surgeon can deal more thoroughly with the diseased parts because he has not to consider the feelings of the patient, and he can from time to time introduce his little finger into the nostril and examine what progress is being made. Furthermore he should, with the exception of a little trimming up at a subsequent sitting, be able to eradicate the disease at one operation, whereas with Grünwald's forceps used during cocaine anæsthesia it may be necessary to operate some half a dozen times.

Hæmorrhage is often free when once curetting has commenced, and the surgeon must depend upon the sense of touch and an intimate knowledge of the anatomy of the region with which he is dealing, rather than upon any actual view of the parts. Carious bone and granulations easily come away during the curetting, healthy bone is more resistant; it is of no moment if one or two healthy cells are destroyed, for the surgeon's object is free drainage and removal of suppurating cells and carious bone. The orbital plate of the ethmoid is in little danger from curetting, but if it be carious and comes away, there will be little harm in the orbital capsule being exposed.

Should hæmorrhage continue after curetting has ceased it may be checked by applying to the ethmoidal region strips of gauze soaked in fresh peroxide of hydrogen solution, or by merely packing a strip of dry gauze into the region operated upon.

If there be no hæmorrhage it will not be necessary to apply any dressing to the parts, but merely keep a small dossil of cotton-wool in the nostril for a couple of days. Twenty-four hours after the operation, the nostrils should be douched with a warm alkaline antiseptic lotion, a treatment which may be persisted in for two or three weeks.

Luc* is in favour of limiting intra-nasal operation to those exceptional cases where the anterior cells are alone slightly diseased. When the ethmoidal suppuration is extensive, and especially when complicated by a fistulous tract into the orbit, or by an orbito-palpebral abscess, he recommends an external operation very similar to that which will be described under frontal sinus empyema (p. 89). His operation only differs from the latter in that the incision is made further downwards over the fronto-nasal suture and the upper part of the lachrymal bone. In this way the ethmoid labyrinth may be brought fully into view and can be efficiently dealt with. As a preliminary he recommends removal of intra-nasal polypi and the anterior end of the middle turbinal. At the close of the operation the facial wound is sutured and drainage takes place into the nose.

For his own part the writer would prefer, under most circumstances, to deal with ethmoidal suppuration by way of the nasal cavity. If the middle turbinal and any other chronic inflammatory products occupying the middle meatal region be first removed, it is surprising how well the anterior ethmoidal region is brought into view, and how easily access may be gained to these parts by means of suitable instruments.

An additional advantage, and one of no small importance, gained by the intra-nasal method, is that there is no external scar or disfiguration, neither is the patient forced to wear an external dressing for several days following the operation. Even in the case of an orbito-palpebral abscess, free removal of diseased tissue by means of a ring knife passed up from the nose, may so destroy the inner wall of the abscess and provide drainage into the nose that no external operation will be necessary.

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* "Leçons sur les suppurations de l'oreille moyenne et des cavités accessoires des fosses nasales et leurs complications intra-crâniennes." (Baillière, Paris).

In such instances as these, however, the frontal sinus will nearly always be found diseased and the external radical operation for the cure of this condition will almost certainly be advisable; under such circumstances it will only be necessary to extend the sinus operation further downwards in order to deal with the ethmoidal suppuration.

Should there be a fistulous tract opening above the internal palpebral ligament or still more externally, it is possible that an external incision may be necessary, but in this case again the frontal sinus operation will probably be necessary and may be extended as in the previous case.

One may sum up by saying that in the majority of cases of chronic ethmoidal suppuration, the trouble can be dealt with from the nose, and in exceptional cases where the disease has gained access to the orbit, the frontal sinus is nearly always affected and both conditions may be efficiently treated by an extension of the radical operation for empyema of the higher sinus.

If the posterior cells be diseased, the whole of the middle turbinal should be removed in order that the surgeon may more fully investigate the field of operation. The removal of that bone should be carried out with the very greatest care because of its important relationships. The writer prefers removing the anterior half by means of scissors and snare as already described and then snaring off the remaining posterior half. In this way there will be little or no tearing of bone or soft tissues. Others prefer to use the turbinotome (fig. 17) or "spoke-shave" which is passed through the nostril from before backwards, engaged over the end of the bone and then rapidly withdrawn. The writer has knowledge of a case where this method was followed by a fatal result owing to a portion of the cribriform plate being torn away at the same time as the middle turbinal. There would be less danger in grasping the bone tightly in a pair of fine polypus forceps and twisting it off on its longitudinal axis.

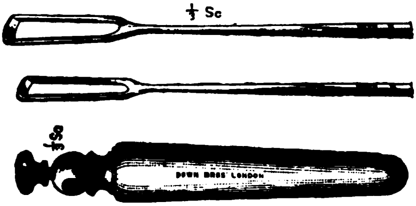

Fig. 17.—Turbinotome.

The posterior cells may then be curetted and dealt with in the same manner as has been described when dealing with the anterior group.

The liability of the sphenoidal sinus to be simultaneously affected with the posterior ethmoidal cells must be borne in mind.

In conclusion it need scarcely be said that whatever appliances or methods of operating be adopted, great care must be taken in the use of instruments in the upper part of the nose, the region of the cribriform plate being especially worthy of respect.

SECTION III.

FRONTAL SINUS SUPPURATION.

Before proceeding to discuss the subject matter of this chapter it may be well to state a few facts relative to the disposition of these bony cavities and to lay particular stress upon such of them as are of importance to the surgeon.

Under normal circumstances "the frontal sinuses are contained in the lower part of the frontal bone above the root of the nose and inner ends of the eyebrows" (Quain). They begin to develop about the seventh year, but remain small until puberty, when they undergo rapid development.

1. They vary much in size (fig. 19) even in the same individual and may be absent on one or both sides. Figure 18 represents sinuses of average size.

2. A complete and imperforate bony septum nearly always separates the sinuses in health, but in disease it is not uncommon for the cavities to communicate with one another through a pathological opening in the septum.

3. In exceptional cases the frontal bone may be almost hollowed out by the sinuses so that they extend outwards to the temporal fossæ, upwards to the frontal eminence, and posteriorly almost to the junction of the frontal bone with the small wings of the sphenoid (fig. 20).

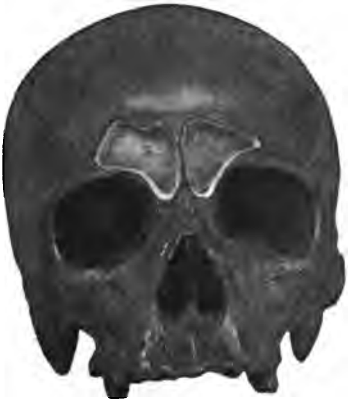

Fig. 18.—Normal sinuses.

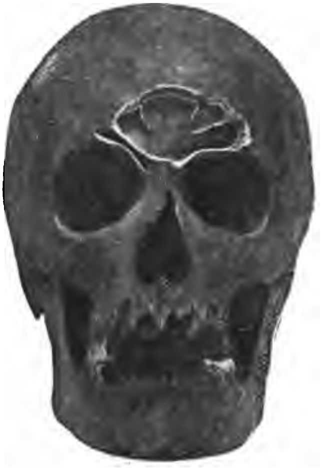

Fig. 19.—A large left and small right sinus.

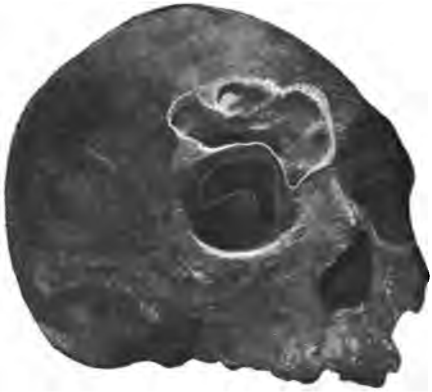

Fig. 20—Extensive right sinus.

For the loan of these three excellent photographs the author is indebted to Dr. Logan Turner, Edinburgh.

4. The external configuration of the forehead or eyebrow gives no clue whatever to the size of the sinuses underneath.

5. The fronto-nasal canal passes through the anterior ethmoidal cells and opens into the middle meatus of the nose at the anterior and upper part of the hiatus semilunaris, into which curvilinear depression are also found the "ostia" or openings of the maxillary antrum and the anterior ethmoidal cells.

6. In many cases the frontal sinus is in almost direct communication with the antrum, as seen in figure 6. It will be noted that the fronto-nasal passage terminates near the antral ostium, from which a fold of mucous membrane extends upwards and inwards, forming a sort of pocket at the bottom of which is the antral opening. Consequently a discharge of pus from the higher sinus would tend to fill the antrum before it appeared in the nasal cavity, and hence the antrum may act not only as a generator but also as a receptacle of purulent discharge.

7. The direction and patency of the fronto-nasal canal varies greatly. From above downwards its direction is slightly backwards, and it may be so curved or tortuous that it would be impossible to enter the sinus from below without making a false passage. In long-standing cases of chronic suppuration of the sinus or ethmoidal cells it is often quite easy to pass a suitably curved cannula into the frontal sinus from the nose.

8. The examination of 120 skulls, kindly placed at my disposal by my former teacher, Professor G. D. Thane, showed that if a small quarter-inch trephine be applied to the lower part of the frontal bone, included between the middle line and a line drawn vertically upwards from the internal angular process, it will in all cases open the sinus on that side if one exists.

Bony septa (fig. 19), generally incomplete, may divide the sinus into larger or smaller recesses Such septa are more common in the outer half of the cavity. Even in comparatively small sinuses it is frequent to find a narrow extension of the sinus towards the external orbital process of the frontal bone. It is in these recesses that chronic inflammatory products are apt to escape the eye and the curette of the surgeon and lead to recurrence of the suppuration.

For fuller information respecting the frontal sinuses the reader is referred to the writer's article on the subject in the *Lancet* of Sept. 26, 1896, and to Logan Turner's in the *Edinburgh Medical Journal*, April and May, 1898.

Ætiology.—The origin of acute and chronic frontal sinus suppuration has already been dwelt upon (p. 39); my own experience would lead me to suggest that acute empyemata are most often the sequel of an acute catarrh of influenzal origin, or a similar condition arising in connection with the acute specific diseases, while chronic empyema is most frequently due to infection from one of the lower sinuses, *e.g.*, chronic ethmoidal or antral suppuration.

ACUTE SUPPURATION.

Symptoms.—The intensity of the symptoms will depend upon the freedom of the outlet for the inflammatory exudation, by way of the fronto-nasal canal. If this be closed there will be intense supra-orbital pain extending to the temporal, parietal and even the occipital regions.

The tissues over the sinus and lower part of the forehead will be tender on pressure and should the pus make its way through the anterior wall of the sinus, redness, swelling and œdema with acute tenderness will indicate the formation of a subcutaneous abscess. The œdema and swelling of the upper eyelid may completely prevent the patient from opening the eye.

Coincident with these local changes there will be sharp pyrexia with its accompanying constitutional symptoms.

In less severe cases there may be slight supra-orbital headache with some œdema of the upper eyelid.

Diagnosis.—There can be scarcely any difficulty in a well marked case, but I have seen mild cases with slight rise of temperature, and with little tenderness on pressure over the sinus, mistaken for neuralgia and vice versa. Examination of the nose may not help much in the diagnosis because there may be so little pus in the sinus that it does not flow into the nasal cavity. Beyond the local symptoms which may exist our chief reliance must be placed on the history of the disease, and a careful comparison of the diseased with the healthy side.

Prognosis.—Many acute empyemata of the frontal sinus recover spontaneously, and of this there can be little doubt. I was once tempted to open a sinus in which, after an attack of influenza, there had been supra-orbital pain for five days, slight tenderness on pressure over the sinus, a suspicion of œdema in the upper eyelid and a temperature varying from 99° to 100°. About two drops of pus were found lying upon the floor of the sinus, and one cannot escape the conviction that the case might have recovered spontaneously.

When the local signs indicate there is distension of the sinus and there are symptoms of acute suppuration, the sinus must be opened immediately, and such cases almost invariably do well.

The danger of intra-cranial extension is less in acute than in chronic suppuration.

Treatment.—Externally warm fomentations should be constantly applied. If they fail to give relief the effect of ice-cold pads of lint may be tried.

From time to time the anterior end of the middle turbinal should be moistened with a twenty per cent. solution of cocaine, in order to produce contraction of the soft tissues in the anterior part of the middle meatus and thus as far as possible remove any obstruction from the lower end of the fronto-nasal canal.

To the same end the patient should frequently inhale mentholised steam, made by adding 10 to 15 drops of a fifty per cent. alcoholic solution of menthol, to a pint of nearly boiling water.

If the anterior end of the middle turbinal be very enlarged and obviously impeding drainage from the sinus, there would be little harm in snaring off the prominent end of the bone.

Failing with these measures the sinus must be opened externally.

Operation.—The eyebrow having been shaved and the skin rendered aseptic, an incision (fig. 22) is made in the eyebrow, commencing about a quarter of an inch above the internal palpebral ligament and curving upwards and outwards just below the line of the eyebrow to about the junction of the inner and middle thirds of the supra-orbital ridge. The supra-orbital nerve should not be divided and if it be in the way it should be held out of danger by a blunt hook.

The soft parts and periosteum are retracted in the length of the wound, and a small disc of bone is removed from the anterior wall of the sinus by means of a chisel and mallet or a quarter-inch trephine. Pus generally exudes at once through the opening, and should be prevented from touching the surrounding soft parts. The sinus may then be syringed out with 1 in 40 carbolic lotion. If necessary more of the anterior bony wall may be removed so that a fuller view of the sinus can be gained. The cavity should be finally cleansed with one in twenty carbolic lotion, or zinc chloride (gr. 40 ad ℥j.) and packed with a strip of iodoform gauze. Sutures may then be inserted in the skin wound but left untied.

In forty-eight hours, the dressing should be removed and replaced by a fresh one. If in the course of a further two or three days the mucous membrane of the sinus seems healthy, the sutures may be drawn together and the superficial wound allowed to heal.

In this operation it is not necessary to enlarge the fronto-nasal canal; if it be quite occluded the passage downwards of an ordinary surgical probe will be quite sufficient to insure its patency.

CHRONIC EMPYEMA.

To this form of sinus suppuration the term "latent" has been applied because it does not manifest its presence by any external symptom, as in the "evident" or acute suppurations already described.

Symptoms.—The symptoms of chronic frontal sinus empyema may be three in number:—(1) a purulent, non-fœtid nasal discharge; (2) frontal or supra-orbital headache or feelings of discomfort, such as a heavy weight or tension in the forehead; and (3) more or less well-marked nasal obstruction caused by the growth of polypi or other chronic inflammatory products within the nasal cavity.

The first symptom is a constant one. The pus is seen in the middle meatus and it is rarely fœtid. The discharge may be profuse, necessitating the use of from ten to twelve handkerchiefs a day. The flow is not so much influenced by the patient's position as is the case in antral suppuration.

Headache may be taken to indicate that pus is retained in the sinus under tension. I have never met with this symptom when the drainage into the nose has been free, but have often cured it by removal of polypi or other obstruction from the middle meatal region. External pressure upwards and inwards on the floor of the sinus may be productive of pain when compared with similar pressure on the normal side, but here again much depends upon whether or not the pus is retained under tension.

In cases of long standing the middle meatus is always more or less blocked with chronic inflammatory products, such as polypi, granulations, or sodden congested mucous membrane. If these be removed the anterior ethmoidal region will be represented by a mass of granulation tissue bathed in pus, amongst which a blunt probe will easily detect tiny spicules of bone or abut against those remnants of the bony skeleton of the ethmoid which have only partially succumbed to a rarefying osteitis. From this lateral mass hangs the middle turbinal in which chronic inflammatory changes identical with those just described have also taken place.

Bearing in mind the frequency with which we meet varying forms of ethmoidal inflammation, the almost constant association of suppurative ethmoiditis with chronic frontal sinus empyema would point very strongly to the infection of the higher by the lower sinuses.

In addition to the symptoms already described the patient's troubles may be aggravated by a dry throat, catarrhal deafness, and a sense of depression, apathy, and inability to work, which are mainly caused by the nasal obstruction already referred to, and partly by the chronic absorption of septic matter from the nasal and gastric mucous membranes.

Chronic frontal sinus empyema is not uncommonly bilateral; in six out of sixteen cases here recorded this was the case. Under such circumstances the sinuses may discharge into their corresponding nasal cavity, being separated from one another by an imperforate septum (Cases 6 and 13), or through a perforation in the septum the cavities may communicate and only empty into one side of the nose (Case 13).

Diagnosis.—A purulent discharge in the middle meatal region almost invariably indicates suppuration of one or more of the nasal accessory sinuses—antral, ethmoidal, or frontal. Headache and nasal obstruction are also symptoms common to empyema of each of these cavities. Hence in arriving at a differential diagnosis each sinus must be carefully examined in detail and the surgeon will find that not rarely they are simultaneously diseased. Since the maxillary antrum is most frequently at fault, it is a good rule of practice to regard every case presenting the characteristic symptoms mentioned above, as one of antral suppuration, until examination proves this assumption to be wrong or incomplete.

Trans-illumination will, as a general rule, afford strong presumptive evidence of the presence or absence of pus in the antrum (p. 48). To make certain, exploration of the sinus may be carried out by means of Lichtwitz's trochar and cannula (p. 51).

If such procedures give negative evidence the source of the purulent discharge must be sought for in the ethmoidal or frontal sinuses. The clinical signs of ethmoidal suppuration have already been referred to, viz., a purulent discharge in the middle meatus associated with a swollen polypoid or granular degeneration of the mucous membrane of the anterior ethmoidal region. A blunt probe passed into the region will easily detect areas of exposed bone or even loose spicules of the same in various stages of rarefying osteitis.

In chronic cases the last mentioned cavities are often associated in disease, and therefore, before examining for frontal sinus suppuration, the surgeon should endeavour to remove all traces of pus from the nasal cavity in general, and from the ethmoidal region in particular. If this be not done, it is quite possible that the irrigation fluid returning from the upper sinus will bring with it a certain amount of pus, due to ethmoidal suppuration, or even some discharge lying in the inferior meatus, and thus it would be impossible to determine what was the original source of the discharge, or whether, if after all the higher sinus may not have been quite healthy.

The cleansing may be carried out by douching the nasal cavity with a warm alkaline antiseptic lotion followed by the application of wool mops to the middle meatus and the region of the anterior ethmoidal cells.

It is well to apply a solution of cocaine (15 to 20 per cent.) to this region before endeavouring to examine the sinus above.

To examine the frontal sinus an attempt should be made to pass into it a suitably curved narrow cannula, such as Hartmann's (fig. 21), and if the effort be successful the cavity may be syringed out with a suitable fluid, such as warm boracic lotion, gr. x. ad ℥j. If there be any pus in the sinus there will be no difficulty in detecting it in the returning lotion.

In this important manipulation, more than one difficulty may confront the surgeon. In the first place, he may not be able to pass the cannula into the fronto-nasal canal, either because he may lack the necessary manipulative dexterity and intimate anatomical knowledge, so necessary in dealing with these regions, or because the canal is narrow, unduly curved, or takes a more pronounced direction downwards and backwards than normal.

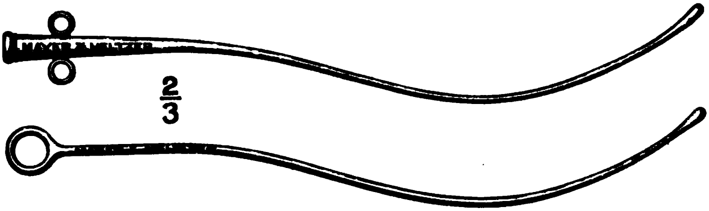

FIG. 21.—Hartmann's cannula.

The more chronic the disease, the easier, as a rule, is it to enter the sinus because the calibre of the fronto-nasal canal has been widened by a rarefying osteitis of the ethmoidal cells through which the canal passes.

Another difficulty of not infrequent occurrence is to determine whether the cannula is in the sinus after it has passed upwards without much resistance. In this matter I think the surgeon may find the following hints useful:—

(*a*). When the upper end of the instrument is in the sinus, the widened proximal end lies close to, if not actually touching, the upper lip.

(*b*). The probability of the cannula being in the sinus will be enhanced if the length of the instrument within the nasal cavity be approximately the same as the external distance measured from the lower edge of the ala nasi to the sinus.

(*c*). A syringe containing air as well as lotion should be fixed to the proximal end of the catheter and an aural auscultation tube should be placed between the surgeon's ear and the anterior wall of the sinus; on injecting the fluid, the " bubbling " of the air and lotion can often be distinctly heard within the sinus and leaves no doubt that the end of the cannula is in the sinus.

No reliance can be placed on the patient's sensation in this matter. It often happens that when the cannula is well within the sinus the patient says he can feel the instrument "pressing against the side of the nose," and indicates the spot by placing his finger over the nasal bone.

Sometimes it is possible to pass a fine probe into the frontal sinus when a cannula cannot be made to enter the cavity, a free discharge of pus following the removal of the probe indicates chronic empyema of the cavity. To avoid mistakes it is again necessary to emphasise the importance of removing all purulent discharge from the middle meatal region before attempting the passage of the probe (p. 93).

The passage of probe or cannula may be rendered impossible by the swollen anterior end of the middle turbinal. Under such circumstances there need be no hesitation in removing the anterior half of that bone, for not only will any future manipulations be rendered easier, but the operation will inevitably be required as a preliminary to any further treatment of the sinus, or even of the anterior ethmoidal cells if it should be found that they alone are the source of the purulent discharge.

Transillumination, so useful in antral suppuration, is of little value in chronic empyema of the frontal sinuses. In order that the illumination of both sinuses may be compared with one another, an instrument has been made by Génisson and Vaast (Paris), in which small electric lamps are contained in two slightly divergent tubes which are placed in corresponding positions upon the floor of the sinuses externally. The results which have been obtained by this method are not very trustworthy.

Prognosis.—The outlook of chronic frontal sinus empyema when left untreated is necessarily bad as regards any chance of nature effecting an ultimate cure.

This is readily conceivable when we bear in mind that under such conditions the mucous membrane lining the cavity has undergone those chronic inflammatory changes which were described in connexion with chronic suppuration of the antrum (p. 63).

On the other hand it cannot be said that untreated cases involve any great danger to life, although three such instances followed by a fatal result have come under the writer's notice, and probably there are more. In each patient death was due to septic osteo-myelitis of the frontal bones, spreading to other parts of the skull and terminating in cortical and sub-cortical abscesses, general pyæmia and death. Such cases are, however, extremely uncommon. The prognosis of intra-nasal treatment alone, is very good as regards the increased comfort afforded the patient, but it does not cure the disease, and although the suppuration may be diminished, it nevertheless continues with those evil effects upon the system already described (p. 3). When the radical operation, hereinafter described, is undertaken and its details carefully carried out, there is every prospect of a permanent and radical cure.

Whether in every case we should advise the patient to submit to this operation is a matter which will be discussed later on.

Treatment.—Whatever treatment be finally adopted it is of paramount importance to ensure free drainage from the sinus by removal of all chronic inflammatory growths from the lower end of the fronto-nasal canal. For this purpose the anterior half or more of the middle turbinal, all polypi, granulations and diseased ethmoidal cells, should be removed by means of curette, snare, or forceps. I have no hesitation in saying that many of the failures in the radical operation have been due to the fact that the external operation has been undertaken before this free drainage and immunity from re-infection of the sinus have been secured by this important preliminary intra-nasal treatment.

When this has been satisfactorily carried out, further treatment resolves itself into one of two measures:—

1. Intra-nasal irrigation of the sinus, and
2. External radical operation.

1. *Intra-nasal irrigation.*—Little can be said in favour of this method as a means of cure. Where intra-nasal treatment alone has been credited with the cure of chronic frontal empyemata, it is highly doubtful whether the disease was not limited to the ethmoidal region, and whether care to exclude the upper sinus had been taken.

Should this cavity be diseased, doubtless intra-nasal treatment will produce relief of certain symptoms and a diminution of discharge, a result which I believe to be entirely due to the improved drainage from the cavity and to destruction of many suppurating ethmoidal cells.

If moreover it be borne in mind that the frontal sinus is irregular in shape and is lined by a mucous membrane which has undergone polypoid degeneration and is freely secreting pus, we can scarcely expect that irrigation, twice or three times a week, with a mild antiseptic lotion through a fine cannula, will restore it to a normal condition. Furthermore, it is a treatment which can only be carried out by the surgeon himself except in very exceptional cases. I have given the method a fair and prolonged trial in four patients, but without any permanent cure in any one case. The solutions used were boric lotion, hydrogen peroxide, iodoform emulsion, carbolic lotion (1 in 60), and antiseptic alkaline lotions.

On the other hand, intra-nasal treatment, including removal of portions of the middle turbinal, polypi, granulations, and suppurating ethmoidal cells, followed by frequent irrigation of the frontal sinus, may so relieve the patient's symptoms and reduce the quantity of the discharge, that he may be content with the improvement and desire no further intervention.

A warning.—More than one surgeon has advocated boring into the sinus from the nose. It cannot be too emphatically stated that this method is unjustifiable, bristles with dangers, and has already been responsible for more than one death from meningitis following shortly after the operation. A glance at the varying anatomy of the region should be sufficient to warn any surgeon of the unwarrantable risks which such a procedure entails. Recently Spiess (Frankfurt) has revived the operation, the manipulation of instruments being carried out under the kindly guidance of the Röntgen rays. To the writer, however, the method seems to add needless difficulties and encumbrances to an unsurgical and unscientific operation which ought not under any circumstances to be contemplated.

2. *External radical operation* (modified Kuhnt's operation).—This involves removal of more or less of the anterior bony wall of the sinus, of its diseased contents, and the provision of free drainage into the nose.

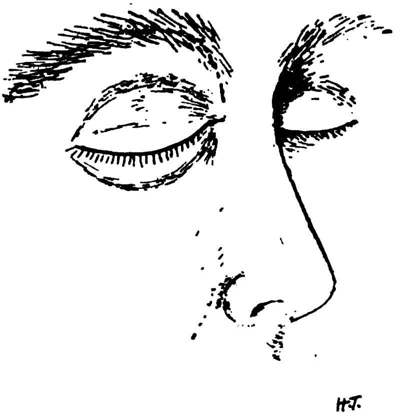

Fig. 22.—Diagram showing line of incision for opening frontal sinus.

The patient having been anæsthetised, the eyebrow shaved,* the skin cleansed, and the posterior choana plugged with a sponge (*vide* Case 1), an incision should be made commencing just above the internal palpebral ligament curving upwards and outwards just below the line of the eyebrow to a little beyond the junction of the inner and middle thirds of the supra-orbital ridge (fig. 22). The soft parts and periosteum are retracted in the length of the wound and a small disc of bone is removed from the anterior wall of the sinus by means of a chisel and mallet or a quarter-inch trephine. Pus generally exudes at once through the opening, as also does the polypoid degenerated mucous membrane. A bent probe should next be passed through the opening in the bone to gauge the extent and limits of the sinus.

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* In the case of female patients it is better not to shave the eyebrow, but only to carefully cleanse the hair and skin.

If the cavity be small and shallow, and more especially if the patient be a male, the surgeon may proceed to remove all the anterior wall, so that at the end of the operation the soft parts will fall in against the posterior wall and obliterate the sinus. If, on the other hand, the sinus is one of average size, I have been practising with success what may be termed a modified Kuhnt's operation, in which a considerable portion, but not the whole of, the anterior wall is removed (fig. 23).

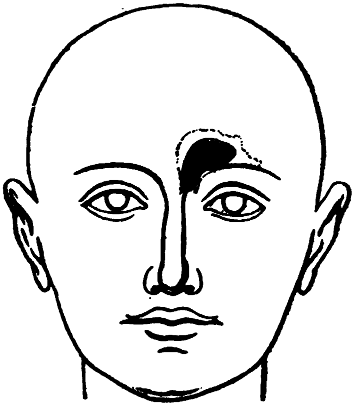

FIG. 23.—The shaded portion illustrates the amount of the anterior wall of the frontal sinus removed in Kuhnt's modified operation as practised by the author. The dotted line represents the outline of a sinus of average size.

Easy access to the sinus having been attained, the diseased mucous membrane should then be carefully curetted away down to the periosteum, and all crevices or extensions of the sinus must be searched out with a small curette or sharp spoon. Special care should be taken to curette and disinfect a narrow outward extension of the sinus usually situated in the supra-orbital ridge. Somewhat free venous hæmorrhage occurs during this part of the operation, but pressure applied by means of small strips of antiseptic gauze will soon check it. The next step is to make a free opening into the nose which may be safely done by means of curved burrs of progressive sizes (fig. 24) or with a suitable curette. In this way suppurating anterior ethmoidal cells are destroyed. The communication between the sinus and the nose should at least be capable of admitting an ordinary lead-pencil, because the success of the operation will greatly depend upon securing free drainage into the nose. The surgeon will find that access to the upper end of the fronto-nasal canal, within the sinus, will be more easily attained if a small portion of the anterior wall of the sinus, situated just above the junction of the frontal and nasal bones, be removed (fig. 23).

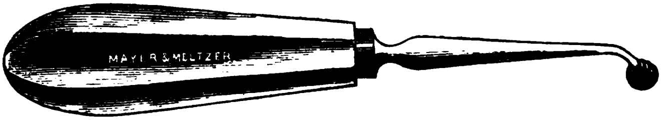

FIG. 24.—Author's frontal sinus burr.

In order to make sure that the upper ethmoidal regions are as free as possible from chronic inflammatory products, it is well at this stage to thoroughly curette the parts with a Mayer's ring knife, inserting the little finger into the nose from time to time to ascertain what progress is being made.

An excellent method for clearing away any loose spicules of bone from the fronto-ethmoidal region is to pass one end of a band of antiseptic gauze from the sinus to the exterior by way of the nasal cavity, the other end projecting from the upper end of the sinus, then holding the ends in the hands a sawing motion is given to the band so that a smooth surface will be given to the fronto-nasal canal.

Having carried out these detail, the sinus should be dried, swabbed out with chloride of zinc (gr. 40 ad ℥j.) or pure carbolic acid and then packed with a strip of antiseptic gauze. The soft parts are finally stitched up, except for the internal third of the wound through which the end of the gauze projects: in doing this care should be taken to bring the edges of the divided periosteum into contact as far as it is possible to do so. An external dressing is then applied.

Provided all goes well, in the course of three or four days about three inches of the gauze may be withdrawn and cut off, the process being repeated every third or fourth day until all the gauze is removed.

It is then my custom to preserve an opening into the sinus by means of a curved piece of silver wire bent upon itself into a shape somewhat like a tracheotomy tube. The free ends are bent outwards at right angles in order to prevent the wire slipping into the sinus When in position the curved end of the wire projects into the nasal cavity, the upper ends resting at right angles upon the skin, external to the wound. This wire drain is daily removed in order to syringe out the sinus with boracic or weak carbolic lotion. When the bony walls are lined with healthy granulation tisue, the wire is finally removed and firm external pressure applied, so that the soft parts may be brought (if possible) into apposition with the posterior bony wall and a partial obliteration of the sinus thus secured.

By this method it is remarkable how little scarring or deformity is produced, and within three weeks from the operation the patient may, as a rule, be discharged.

Kuhnt recommends that the entire anterior bony wall be removed, in order that the sinus may be completely obliterated, but the great disadvantage of such a radical operation is the marked deformity which results, and that it is quite unnecessary in a number of cases, has repeatedly been demonstrated in patients which have been shown at meetings of the Laryngological Society of London (*vide Transactions*, 1900-1901) in which the modified operation, as above described, has been carried out. In the majority of cases the cosmetic result leaves nothing to be desired and the purulent discharge has been permanently cured.

If the antrum also contain pus an alveolar drain should be inserted and the antrum irrigated thoroughly for a few days before the radical operation on the higher sinus is undertaken. If, after the cure of suppuration from the frontal sinus, the discharge from the antrum continues in spite of irrigation, it may be necessary to explore that cavity by the radical method already described (p. 64); it will often be found to contain a diseased mucous membrane which must be curetted away and the cavity packed or irrigated until its lining membrane is restored to a healthy condition.

At the end of this chapter is appended a list of sixteen cases which have been treated by various means, and in the description of which the "radical operation" refers to the modified Kuhnt's operation which has here been described in detail. This method has given me such excellent results that it seems unnecessary to describe any of the other operations which have been advocated from time to time, most of which produce considerably more deformity than is agreeable or necessary.

It is unfortunately true that some eight or nine fatal cases (to my knowledge) of septic osteo-myelitis have been recorded after radical operations upon the frontal sinus and apparently due to its performance. It is, however, only fair to add that these have occurred during the evolution of the operation as above described, and in all cases the untoward result has been due to the fact that free drainage into the nose has not been ensured at the time of the operation; the external wound has been tightly sewn up, suppuration has recurred and the septic matter has been forced into the recently opened diploë of the frontal bone causing a spreading septic osteo-myelitis, with ultimately fatal results.

COMPLICATIONS.

(*a*). *Recurrence of suppuration in the sinus.*—Such an unfortunate result is most often owing to re-infection from the nose, and in many cases it is due to the fact that the surgeon has failed to make a sufficiently free opening into the nasal cavity and the suppurating ethmoidal cells which surround the fronto-nasal canal have not been effectually removed. Hence the value of the preliminary intra-nasal treatment and of careful curettage of the ethmoidal region during the later stages of the radical sinus operation.

(*b*). *Diplopia.*—This is owing to disturbance of, or inflammatory exudation around, the pulley of the superior oblique muscle. It rarely lasts for more than a week or ten days and should not occur at all if due care be taken in retracting the soft parts in the neighbourhood of the trochlea.

(*c*). *Anæsthesia of the forehead and scalp.*—This is the result, often unavoidable, of division of the supra-orbital branch of the fifth nerve, and it is well to warn the patient of its possibility before the operation is performed.

The numbness of the skin and scalp is often not so trying to the patient as the formication which supervenes some five or six weeks later. This symptom may be partially relieved by belladonna liniments or the application of the faradic current.

(*d*). *Septic osteo-myelitis of the frontal bone.*—This is a serious complication which with due care should never arise. It manifests itself by local tenderness, redness, and œdema of the soft parts in the neighbourhood of the wound, the lower part of the forehead and the bridge of the nose. Coincident with such local changes are a rise of temperature and associated constitutional symptoms.

The stitches and dressings should be at once removed from the wound, and moist layers of iced boracic lint constantly applied. Should the œdema and tenderness spread, the only chance for the patient lies in the surgeon thoroughly opening up the wound and removing the anterior table of the frontal bone for an inch or so around the sinus, in order that he may freely expose the septic phlebitis of the diploëic veins and check the progress of the inflammation. It need scarcely be said that the latter is an extremely difficult task to accomplish, but it has been successful in a case where the anterior table of the lower half of the left frontal bone was removed. The complication is always a very serious one and most commonly fatal, often after months of suffering, during which the scalp becomes undermined by chronic sub-periosteal abscesses, while the patient slowly sinks from septic intoxication, or from a form of chronic pyæmia.*

Before concluding this subject it may be worth while endeavouring to answer a very important question which must inevitably occur to the surgeon when he has to deal with a case of chronic frontal sinus empyema, viz., What circumstances should determine us in advising the external radical operation?

We have to consider:—(1). *What is the fatality of such cases when left untreated?*—The most enthusiastic surgeon will be forced to admit that it is not very great. During the past ten years I have seen two spontaneously fatal cases, three fatal after operation (although one of these was in a hopeless condition of septic osteo-myelitis before being operated upon), and I have notes of seven other cases occurring at home and abroad. Hence it would seem that cases which have been operated upon are attended by greater fatality than the few which have died when left without treatment. It is, however, probable that the present mode of treatment will in future be attended with very slight mortality, but it does not alter the fact that untreated cases are rarely fatal, however much inconvenience the symptoms may cause the patient.

(2). *The probability of cure if the operation be undertaken.*—In an operation, the preliminary and final stages of which demand so intimate a knowledge of the anatomy of the parts involved, so great an amount of patience in getting the ethmoidal regions free from pathological conditions before entering on the external operation, and so many attentions to detail in this latter stage and its after treatment—when these points are borne in mind, it will at once be obvious how much the ultimate result of the operation must depend upon the experience of the surgeon in these particular cases. A little pocket of diseased mucous membrane left in the sinus, an inefficient opening into the nose, the existence of suppurating ethmoidal cells close to the floor of the sinus, may each one of them easily spoil what has otherwise been a well executed operation.

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* *Vide British Medical Journal*, October 14, 1899.

On the other hand, if such details are carefully observed, I think we may honestly promise our patients a lasting cure.

(3). *Scarring and deformity.*—In the modified Kuhnt's operation the scarring is so slight than in three months' time it may be practically invisible.

The more of the anterior bony wall that is removed, the greater the probability of noticeable deformity.

(4). *How much relief can be given by intra-nasal treatment alone?*—In very many cases the answer to the main question will turn upon this one. At the time of writing the author has under his care seven cases of chronic frontal sinus empyemata in which removal of the anterior half of the middle turbinal, polypi, and suppurating anterior ethmoidal cells has so relieved all symptoms and diminished the suppurative discharge that the patients are quite satisfied to go on without further treatment, or as one of them says: "So long as I have no headache and can breathe freely through my nose, I don't mind a drop of pus which only needs one handkerchief a day."

SIXTEEN CASES OF CHRONIC EMPYEMA OF THE FRONTAL SINUS.

No.	Sex and Age.	Date when seen.	Duration of Symptoms.	Sinuses involved.	Treatment.	Result.	Remarks.
1	M., 38 years.	October, 1896.	18 years.*	Double frontal sinuses; double maxillary sinus (empyema).	Alveolar drainage of antra; external radical operation on the frontal sinuses.	Sinuses cured. There was a slight discharge in irrigation of the antra (Feb., 1900).	The patient nearly died under operation owing to the post-nasal space not having been plugged prior to operation; blood, therefore, flowed freely into the lungs during operation.
2	F., 22 years.	June, 1897.	7 years.	Both frontal sinuses and ethmoids.	External radical operation.	Fatal, after seven months suffering from chronic septic osteomyelitis.†	This, my only fatal case, was certainly due to imperfect drainage into the nose and tightly stitching up the wound at the close of operation. Suppuration recurred in the sinuses and pus entered the freshly opened diploë of the frontal bone. Seven similar cases have been recorded.
3	F., 37 years.	March, 1898.	5 years.	The left frontal sinus and both maxillary antra.	Radical operation on the left sinus and antrum; intra-nasal opening and irrigation of the right antrum.	Cure.‡	The drainage in this case was secured by Luc's§ method (*vide infra*).
4	F., 19 years.	April, 1893.	5 years.	Both frontal sinuses.	Radical operation on both sinuses at intervals of three months.	Cure.	The drainage in this case was secured by Luc's method.
5	F., 36 years.	May, 1899.	25 years.	The right frontal sinus and the right maxillary antrum.	Removal of mid-turbinal and irrigation of the sinus; alveolar drainage of the antrum.	Cure.	This is the only chronic frontal sinus emryema I have known cured without external operation.
6	M., 35 years.	June, 1899.	10 years.	Both frontal sinuses.	Irrigation of sinuses and intra-nasal treatment.	The headaches were completely cured and the discharge was greatly diminished.	On syringing into the left sinus the fluid returns from the right nostril, showing perforation of the septum. The patient only requires to use one handkerchief a day.
7	M., 52 years.	July, 1859.	9 years.	The right frontal sinus and the right maxillary antrum.	Intra-nasal treatment and sinus irrigation; alveolar drainage of the right antrum.	The headaches were cured but there was a slight discharge from the sinus and antrum.	Profuse hæmorrhage (arterial) followed puncture of the alveolus. It was only checked by plugging the antrum and middle meatus with gauze.

8	F., 27 years.	October, 1889.	3 years.	The left frontal sinus and the left antrum.	External radical operation; alveolar drainage.	Cure of the sinus suppuration; slight discharge from antrum.	The headaches have entirely ceased and the patient has gained 16 lb. in weight since the operation, the general health being excellent.
9	F., 42 years.	October, 1899.	5 years.	The right frontal sinus and antrum.	Radical operation on the sinus; alveolar drainage of the antrum.	The discharge was greatly diminished.	The wound was completely stitched at the close of the operation and the gauze was removed from the nose, followed by irrigation from the nose: an unsatisfactory method.
10	F., 16 years.	December, 1899.	3 years.	The right frontal sinus and antrum.	Radical external operation on the sinus and antrum.	Cure.	The sinus being small, the cavity was practically obliterated by free removal of the anterior bony wall.
11	M., 20 years.	December, 1899.	4 years.	Both frontal sinuses and both maxillary antra.	Radical external operation on the left sinus. Both antra were drained through the alveolus.	Cure.	The sinus being small, was obliterated as in the last case. The resulting depression is scarcely noticeable.
12	F., 30 years.	February, 1900.	3 years.	Both frontal sinuses.	External radical operation.	Relieved, but slight discharge from the sinus continues.	
13	F., 19 years.	April, 1900.	2 years.	Both frontal sinuses.	External radical operation.	Cure.	The sinuses communicated through the septum. They were very large. Although the right sinus was diseased there was never any trace of pus or disease in the right nasal cavity.
14	F., 50 years.	May, 1900.	5 years.	Left frontal sinus and the left maxillary antrum.	External radical operation on the sinus; alveolar drainage of the antrum.	Cure.	The sinus was packed for three days and then syringed cut twice daily for a fortnight through a small india-rubber tube passed through the sinus and out of the corresponding nostril.
15	F., 38 years.	November, 1900.	4 years.	Left frontal sinus and left maxillary antrum.	External radical operation on the sinus; alveolar drainage of the antrum.	Cure.	The anterior wall of the sinus was entirely removed (Kuhnt's method).
16	F., 40 years.	January, 1901.	7 years.	Right frontal sinus and antrum.	External radical operation on the sinus and alveolar drainage of the antrum.	Cure.	

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* *Brit. Med. Journ.*, 1897. † *Brit. Med. Journ.*, 1899.

‡ By the word "cure" is meant absolute cessation of the discharge from the sinus.

§ Luc's modification of the radical operation involves two special features—(1) draining the sinus by means of a convolvulus tube, the expanded end of which rested in the infundibulum, the lower end projecting from the corresponding nostril; and (2) complete suture of the external wound. The operation is now rarely performed.

In Case 6, the patient speaks of his case as "cured," although there is still a slight discharge from his sinuses. When he first saw me there was complete bilateral nasal obstruction and he was scarcely ever free from headache. He is a young engineer just getting on in his profession, and in his present satisfactory condition, however inimically one may regard a pus-producing focus in the body, I do not feel justified in urging a radical operation on his sinuses, a procedure which must necessarily lay him up for some three or four weeks.

I would therefore suggest that when intra-nasal treatment gives relief to all urgent symptoms, and the discharge of pus is diminished or is very slight, causing the patient no obvious inconvenience, the radical operation should not be urged by the surgeon.

If, on the contrary, intra-nasal treatment gives no relief to headache, if the patient is unduly sensitive of a slight purulent nasal discharge, if the latter causes gastric symptoms or grave disturbances of the general health, if the patient is going abroad where skilled help or examination of the nasal cavities is not obtainable, then the radical operation may be advised, and if carried out with the precautions observed it may be regarded as practically free from danger, as unlikely to leave scarring or deformity, while it has every prospect of yielding results gratifying alike to both patient and surgeon.

SECTION IV.

EMYPEMA OF THE SPHENOIDAL SINUS.

The anatomical relationships of the sphenoidal sinuses are as variable as those which have been discussed in connection with the frontal accessory cavities.

The following facts should be borne in mind by those who desire to undertake the treatment of disease in this deeply seated bony cavity.

It must be understood that any figures here given are only the *average* measurements, which have been determined from the examination of some 50 to 100 skulls, in living subjects as well as in moist and dried preparations.

1. The sinuses are usually separated by a bony septum of considerable thickness which is rarely perforated either in health or disease.
2. The anterior wall of the sinus practically forms the upper edge of the posterior nasal choana.
3. The normal opening into the sinus is situated in the spheno-ethmoidal recess.
4. Occasionally the sphenoidal opening is situated nearer to the septum than the recess spoken of.
5. The size of the ostium varies greatly, it may barely admit the passage of a fine probe, or it may easily be entered by a full-sized surgical probe.
6. The average distance of the ostium above the posterior end of the middle turbinal is about 12 mm. (Holmes, Cincinnati).

7. Under normal circumstances there is rarely any connection between the posterior ethmoidal cells and the sphenoidal sinus.

8. In only about 40 per cent. of cases would it be possible to pass a probe into the sinus because of obstructions formed by the middle turbinal or ethmoid cells.

9. The walls of the sinus vary greatly in thickness, they may be thin to dehiscence or almost impenetrably thick. The importance of the former condition is obvious in the case of empyema of the cavity.

10. It is in reference to the thinness of the outer wall of the sinus bordering the optic foramen that Holmes says:—"It is from extension of the disease existing in the sphenoidal cavity, through this thin wall, that many cases of obscure retro-bulbar neuritis develop, and often end in blindness; and it is through the lateral wall that the inflammation can extend to the bundle of nerves and vessels as they pass through the sphenoidal fissure (Plate VI.), causing neuralgia of the first division of the fifth, and this may, in a measure, explain why we have this branch far more frequently affected than the other two."

The accompanying plate, for the use of which I am indebted to the last named author, shows exceedingly well the relationship of the sinuses to the contents of the sphenoidal fissure, optic foramen and foramen rotundum.

The section is taken directly in front of the optic chiasma, cutting through the optic foramina. It illustrates clearly the paper-like thinness of the bone separating the sinus cavity from the optic canal and sphenoidal fissure.

11. The average distance of the ostium sphenoidale

from the skin of the upper lip at the entrance of the nostril is, according to Grünwald, 7·6 mm. in females and 8·2 mm. in males.

12. To enter the sinus with a probe, the latter should be passed upwards and backwards between the middle turbinal and the septum, crossing the former at the junction of its middle and posterior thirds.

Ætiology.—This differs in no way from that of the other accessory cavities, although it would seem that most cases of sphenoidal sinus suppuration arise from acute infection rather than as an extension of chronic mucous membrane inflammation. Not uncommonly the sphenoidal cavity is infected by extension of the suppuration process from the posterior ethmoidal cells.

Pathology.—Similar changes to those met with in other sinuses are found in the sphenoidal cavity.

In chronic cases, a thickened mucous membrane going on to papillary degeneration may be met with, while in advanced cases necrosis or carious areas of the bony wall may be present. The opening of the sinus being badly situated for drainage accounts for the inspissation and fœtor of the pus in certain cases.

Acute empyema of the sphenoidal sinus is rarely met with and little need be said of it here. The symptoms include severe headache with the constitutional symptoms usually associated with pyrexia, while the diagnosis and treatment are practically identical with those of chronic empyema of the cavity.

CHRONIC EMPYEMA.

Symptoms.—Pain. The pain associated with chronic suppuration in the sphenoidal sinus will vary greatly with the degree of tension under which the inflammatory products are retained, hence where the ostium is fairly patent there may be no pain and only careful examination by means of a probe may enable the surgeon to discern the source of the purulent discharge. On the other hand, the patient may suffer from deep-seated pain in the head, occipital headache, pain on the vertex or in the temporal region, or severe supra-orbital or infra-orbital neuralgia. Both these forms of neuralgia are also common with antral suppuration, and in both diseases there may be a periodicity in the onset of the pain very suggestive of malaria.

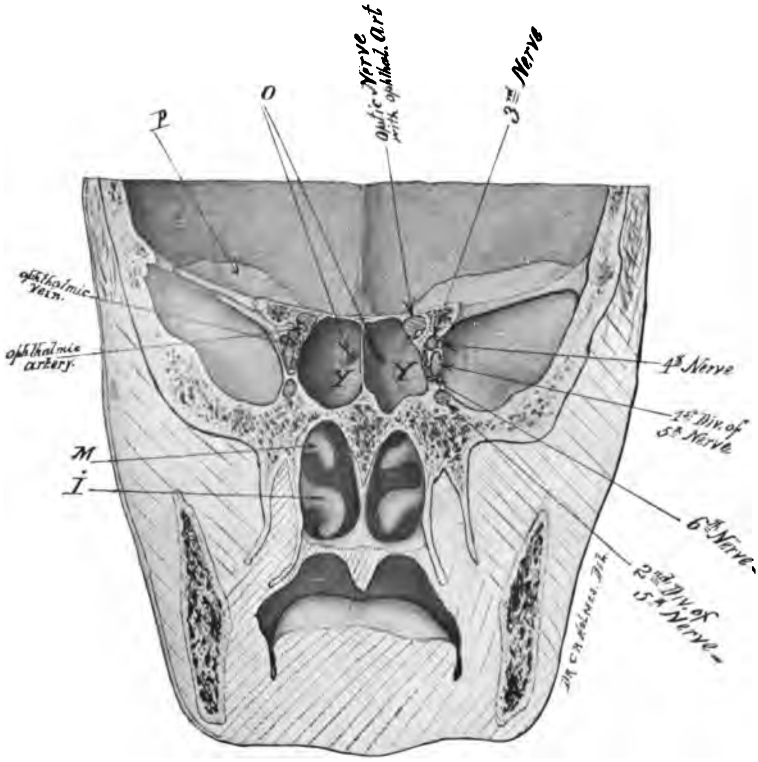
In other cases the pain is referred to the back of the eye. Reference to Plate VI. will easily explain these variations in the situation of this symptom, according to the nerves involved.

Grünwald cites a case in which the spheno-palatine ganglion became affected during the course of chronic empyema of the adjoining sinus, the result having been a diminution in the sensibility of the corresponding side of the face from the upper eyelid to the upper lip.

Ocular symptoms.—The extension of inflammation from the sinus not only to the optic nerve, but to the blood-vessels and nerves of the sphenoidal fissure, and the effect of distension of the sinus upon the contents of the orbit, accounts for the varied eye symptoms which may be present in empyema of the sphenoidal cavity.

Among these may be mentioned, various degrees of

PLATE VI.



SECTION OF SKULL IN FRONT OF OPTIC CHIASMA CUTTING THROUGH THE OPTIC FORAMEN.
P. ROOF OF FRONTAL SINUS. O. SPHENOIDAL OSTIA. Y. SPHENOIDAL SINUS.

retro-bulbar neuritis, congestion of the fundus, pain in the eye, tenderness to pressure on the globe, and visual defects described by the patient as "cloudy" or "blurred," vision which may pass on to actual blindness. This is often of rapid onset, and according to Burger, the peripheral vision is first lost. In addition there may be paralyses of the ocular muscles including the iris and ciliary body. Conjunctivitis and slight exophthalmos may also be present.

All such symptoms may be explained by the extension of inflammation from, and the pressure of, the distended sinus upon the adjacent nerves and vessels.

Pus.—The discharge as a rule is not free and it has a tendency to dry, forming a crust or scab over the opening into the sinus or upon the posterior pharyngeal wall.

Posterior rhinoscopy will often enable one to see the pus covering the posterior ends of the middle or inferior turbinals. If it should flow forwards it is generally seen between the septum and middle turbinal, but this is not constantly the case for it may find its way into the middle meatus and thus simulate frontal, ethmoidal, or antral empyemata. The pus is sometimes offensive, and according to Grünwald, if caries or necrosis of the walls of the sinus be present the scabs are greyish-green and fœtid and resemble those met with in "ozæna."

Besides these, other more indefinite symptoms are often present, such as inability to concentrate the mind, feelings of oppression, weight in the head, &c. Some of these are probably accentuated by suppurative lesions in the other cavities, for it is uncommon to find the sphenoidal sinus alone affected.

Diagnosis.—When headache or neuralgia, with well marked ocular symptoms are associated with a purulent discharge into the naso-pharynx, there is little difficulty in coming to a right diagnosis.

It is different when all the symptoms are less pronounced and the difficulties are immensely increased when, as is generally the case, other sinuses are simultaneously involved in the suppurative process.

Under such circumstances it will be easy to ascertain the presence of pus in the antrum and little time will be wasted before dealing with diseased ethmoidal cells, or relieving obstruction to the flow of pus from the frontal sinus by removing the middle turbinal.

The continuance of symptoms after such measures have been carried out should lead us to look still further afield and examine the sphenoidal sinus.

The presence of pus in the naso-pharynx and covering the posterior end of the middle or inferior turbinals as well as its appearance between the septum and middle turbinal afford presumptive evidence of suppuration within the sinus.

All purulent accumulation in the naso-pharynx should be removed by means of a suitable douche or wool swabs, and then an attempt should be made to explore the sinus by means of a suitable nasal probe.

This should be passed upwards and backwards between the septum and middle turbinal crossing the latter about the junction of its posterior and middle thirds. The distance of the sphenoidal opening from the junction of the skin of the upper lip and the nostril is between 7 and 8 mm.

If the probe pass into the sinus cavity it will of course be impossible to move it vertically downwards, and in this way it may be possible for the surgeon to determine when the sinus has been entered.

The discharge of pus. following the passage of the probe will place the diagnosis of empyema beyond doubt. By careful manipulation the presence of carious areas in the walls of the sinus may be ascertained.

Further evidence of purulent accumulation may be gained by using a cannula in place of the probe and irrigating the sinus.

In a number of cases it will be found necessary to remove the whole of the middle turbinal before these manipulations can be carried out and with due care there need be no hesitation in doing so.

Treatment.—If there be a fairly wide opening in the anterior sinus wall and no marked symptoms of purulent retention, irrigation of the sinus by antiseptic lotions is all that is called for. It is a question indeed whether, bearing in mind the important anatomical relationship of the parts, it is justifiable to do any more.

For the very same reasons, it is equally imperative, when symptoms of retention are present, to make a freer opening into the anterior wall.

In the performance of this operation, the surgeon will find that the index finger of the left hand, passed to the roof of the naso-pharynx of the patient, will serve as an excellent guide to the sinus, and by its means he will be able to steady the instrument passed through the nostril with the right hand.

His endeavours should be limited to:—

1. Breaking down the anterior wall of the sinus, until a sufficiently large aperture for drainage purposes has been established.

2. Gentle curettage of the degenerated mucous membrane lining the cavity.

The instruments used consist of various sized sharp spoons, inclined at an obtuse angle to their handles, a shape which is common in many other instruments used in the treatment of nasal diseases.

It need scarcely be said that surgical interference with the sphenoidal sinus should be relegated to those who are intimately acquainted with the anatomy of the parts involved, and whose daily avocation ensures their familiarity with all the details and technique of intranasal surgery.

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